# Development of a Consumer Satisfaction Based Model for the Provision of Sustainable Rural Water Supply in Malawi

Submitted by

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*I dedicate this work to our Holy Mother, Mary the Mother of Christ our Saviour*

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*“Hail Mary, full of grace the Lord is with you, blessed are you among women and blessed is the fruit of your womb Jesus. Hail Mary mother of God, pray for us sinners, now and at the hour of our death, amen”*

## Abstract

The overall aim of the current research is to develop a consumer satisfaction based practice framework for stimulation of consumer practices essential for sustainability of rural water supply. This is achieved in the current research by identification of sustainability structural pillars essential for supporting performance of rural water supply service level indicators. It involves identification of root causes of problems that fail the sustainability pillars, developing solutions and strategies for increasing consumer satisfaction and sustainability.

Findings from rural water supply sustainability research have shown that consumers' behaviour is important for sustainability of rural water supply. However, existing knowledge regarding consumer behaviour and rural water supply sustainability is weak and sketchy.

In line with the current debate on universal access to water and sanitation as a human right across the globe and more specifically, the debate on the high percentages of people not having access to safe water in right quantities and within an acceptable distance; including the deadly consequences of having no access to safe drinking water, the current research sets to explore whether focusing on consumer satisfaction can stimulate positive consumer behaviour which is needed for rural water supply sustainability.

Drawing upon findings from rural water sustainability studies among them Montgomery et al., (2009) and Ungwe (2015) and customer satisfaction studies from Oliver (1999) and others, the current research examines the behaviour benefits of consumer satisfaction on rural water supply sustainability. Thirteen factors are found to be root causes of sustainability failure and eighteen solutions have been developed to manage rural water sustainability. Six strategies for improving performance of service level indicators have been developed in the current research.

Using a mixed methods approach for data collection and analysis, the current research used a survey method (n=384), and semi-structured interviews through focus group discussion (n=24) and twelve key informant interviews in a ten cases multiple case study to collect data. This was done with the aim to investigate and understand underlying problems behind low consumer satisfaction and poor borehole rural water supply systems sustainability. Boreholes are a predominant source of safe water in rural areas of Malawi.

Results showed that there are thirteen root causes that are responsible for failing sustainability pillars and only if they are managed that is when sustainability and consumer satisfaction will improve. Eighteen solutions packaged with problem root causes as a prescription have been developed. The current research has concluded that focusing on

improving consumer satisfaction is good because consumer satisfaction is a statistical predictor of consumer behaviour and that the more satisfied the consumers is, the more likely the consumer will display desired behaviours for rural water sustainability.

Overall the findings explored the role that customers have to play in improving water supply sustainability and offered empirical evidence on linkages between consumer satisfaction and rural water supply sustainability, giving a new insight into the debate on rural water supply sustainability in Malawi and providing important implications for policy. The current research has offered a practical framework for project managers, donors, funders, government and other rural water supply service providers to adopt and use in order to reduce incidences of non-functionality of water systems in rural areas of Malawi.

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## Declaration

I, Peter Andy Matipwiri, certify that this thesis is solely my own work other than where I have clearly indicated that it is work of others. The copyright of this thesis rests with the researcher. Quotations from it is permitted, provided that full acknowledgement is made. The thesis may not be reproduced without the prior consent of the researcher. I warrant that this authorization does not, to the best of my belief, infringe the rights of any third party.

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## List of Abbreviations

| | |
|---|---|
| ADP | Area Development Programme |
| ANOVA | Analysis of Variance |
| CM | Community Members |
| CM | Community Management |
| DEHO | District Environmental Health Officer |
| DFID | Development Fund for International Development |
| DHS | District Health Survey |
| DPD | District Planning Department |
| DS | Desired State |
| EA | Enumeration Areas |
| HSA | Health Surveillance Assistant |
| IPs | Immediate Problems |
| IRs | Immediate Results |
| IS | Immediate Solution |
| LC | Learning Centre |
| MDG | Millennium Development Goals |
| MWASH | Malawi Water Sanitation and Hygiene |
| NGO | Non-Governmental Organizations |
| NSO | National Statistical Office |
| NSO | National Statistics Office |
| O&M | Operation and Maintenance |
| OMM | Operation, Maintenance and Management |
| PEA | Primary Education Advisor |

| | |
|---|---|
| POOM | Private Owned Operation and Maintenance |
| POOM | Private Ownership Operation and Maintenance |
| PPOM | Public Private Operation and Maintenance |
| PPOM | Public Private Operation and Maintenance |
| PPP | Public Private Partnerships |
| PSU | Primary Sampling Unit |
| $S_n$ | $Strategy_{(n)}$ |
| SAD | Single Approach Designs |
| SAR | Southern Africa Region |
| SAT | Satisfaction Acceptable Targets |
| SLPIs | Service Level Performance Indicators |
| SPSS | Statistical Package for Social Scientists |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| VLOM | Village Level Operation and Maintenance |
| VLOM | Village Level Operation and Maintenance |
| WAS | Water Assurance Scheme |
| WASH | Water Sanitation and Hygiene |
| WEDC | Water, Engineering, and Development Centre |
| WPC | Water Point Committee |
| WSP | Water and Sanitation Programme |
| WSS | Water Supply and Sanitation |
| WVI | World Vision International |
| BRWSS | Borehole Rural Water Supply System |

# CHAPTER 1: BACKGROUND TO THE CURRENT RESEARCH

*"Sometimes we focus so much on the big number that we fail to see human tragedies that underline each statistic. If 90 school buses filled with kindergartners were to crash every day, with no survivors, the world would take notice. But this is precisely what happens every single day because of poor water, sanitation and hygiene".*

*Sanjay Wijesekera (UNICEF)*

## 1.0 Introduction and Overview

Access to safe and sufficient water is a basic human need and is essential for human wellbeing (UN, 2006). Everyone needs safe drinking water yet most rural poor people today, particularly in less developed countries do not have access to safe water. Many rural poor people especially in sub Saharan Africa who had access to safe drinking water from protected water sources are either going back to the unprotected water sources or are walking longer distances to access safe water elsewhere because their protected water source is now not functional, mostly affected by such situations are children, the chronically sick, the aged and people with disability (Lockwood, 2004). In fact the situation justifies Harvey and Reed's assertion that, in terms of boreholes sustainability "a non-functioning hand pump is a stark symbol of unfulfilled expectations and unchanging poverty" (Harvey and Reed, 2004: 84).

The overall aim of the current research is to develop a consumer satisfaction based practice framework that would assist in stimulating consumer practices or behaviours essential for sustainability of rural water supply. This is achieved by identification of problem root causes of consumer dissatisfaction and evaluating means used in other scenarios in curbing consumer dissatisfaction and hence triggering display of desired consumer behaviours for sustainability of rural water supply. Improving the sustenance of community water supply has a number of merits: It ensures the ongoing provision of a service that is fundamental to improving life and health, enables water users to live a life of dignity (Adigun & Bamidele, 2013).

So far countries like Ethiopia, Rwanda, Senegal, and South Africa are a living examples of countries that pioneered achieving the MDG on water and sanitation in sub Saharan Africa in 2015 (UN Water, 2015). Four common themes commonly exist in these countries towards achievement of their targets like 1) Public participation through deliberate engagement and communication; 2) Accountability through monitoring and local commitment; 3) Sector coordination through single organization leadership and vision and; 4) Ability to balance public service with business – oriented delivery.

Globally by 2015 better progress had been achieved on improving access to safe water as now 91% of the global population uses an improved water source from 76% in 1990. The number of people who lack access dropped from 700 million to 663 million in 2015 (UN Water, 2015).

Five developing regions met the MDG drinking water target, but Caucasus and Central Asia, Northern Africa, Oceania and sub Saharan Africa did not. What is common is that the least developed countries did not meet the MDG water access target despite that 42% of their population gained access to improved water sources in 2015 since 1990. Nearly half of the people using unimproved drinking water sources live in sub-Saharan Africa, while one fifth live in southern Asia (UNICEF & WHO, 2015). Even though some of the global and regional situations seems impressive but still 663 Million people are at risk of health, social and economic vulnerability due of lack of access to safe water hence the onset of the SDG global action for all.

According to UN Water (2015) there are seventeen Sustainable Development Goals (SDG) and goal six contains six targets on outcomes across the entire water cycle, and two targets on the means of implementing the outcome Targets. The seventeen Sustainable Development Goals are as follows:

Goal 1: End poverty in all its forms everywhere
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3: Ensure health lives and promote well-being for all at all ages
Goal 4: Ensure inclusive and equitable education and promote lifelong learning opportunities for all.
Goal 5: Achieve gender equality and empower all women and girls
Goal 6: Ensure availability and sustainable management of water and sanitation to all
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10: Reduce inequality within and among countries
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12: Ensure sustainable consumption and production patterns
Goal 13: Take urgent action to combat climate change and its impact

Goal 14: Conserve and sustainably use the oceans seas and marine resources for sustainable development.
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss
Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective and accountable and inclusive institutions at all levels.
Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The Goal #6 is about water, sanitation and hygiene and to be more specific this goal has six targets as follows:

a) 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
b) 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
c) 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials having the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
d) 6.4 By 2030, substantially increase water use efficiency across all sectors and ensure sustainable withdraws and supply fresh water to address water scarcity and substantially reduce the number of people suffering from water scarcity.
e) 6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
f) 6.6 By 2020, protect and restore water related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
    a. 6.6a - By 2030, expand international cooperation and capacity building support to developing countries in water and sanitation related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
    b. 6.6b-Support and strengthen the participation of local communities in improving water and sanitation management.

SDG Target 6.1 and 6.2 build on the MDG target on drinking water and basic sanitation, providing continuity while expanding their scope and refining definitions. SDG Target 6.3 to 6.6 address the broader water context that was not explicitly included in the MDG framework, but whose importance was acknowledged at the Rio+20 conference, such as water quality and waste water management, water scarcity and use efficiency, integrated water resources management, and the protection and restoration of water-related

Photo 1: Child drawing water at a borehole in one of the research areas in Malawi

ecosystems. SDG Target 6.6a and 6.6b acknowledge the importance of an enabling environment, addressing the means of implementation and aiming for international cooperation, capacity-building and the participation of local communities in water and sanitation management.

With water at the very core of sustainable development, SDG #6 does not only have strong linkages to all of the other SDGs but it also underpins them; meeting SDG #6 on water, sanitation and hygiene would go a long way towards achieving much of the 2030 agenda (UN Water, 2015).

The current research is designed to improve sustainable access to safe drinking water by developing a consumer focused water supply model. The model will stimulate increase in desired rural water consumer behaviours essential for sustainable operation and management of rural water supply. The researcher anticipates that with increased positive rural water consumer behaviour then a reduction on non-functionality incidences of rural

water supply will be achieved, and thus contributing to progress towards universal access to safe drinking water by 20130 (SDG #6).

According to UNDP-WSP (2006), rural water system functional sustainability largely depends on the willingness of users to provide the necessary time, effort, money and labour to keep the system functioning; in other words ownership and self-reliance, now in a way agreeing with Nieves (1980) assertion that service providers are failing to capture interest of the users. UNDP- WSP (2006) says that willingness may be affected by other socio-economic factors such as income level, ethnic homogeneity, or the willingness of villagers to work together. Nieves (1980) says that willingness will largely depend on consumer satisfaction with the service, usually compared to the previous water source in a community.

Literature, overwhelmingly identifies non-functionality of water facilities on the beneficiaries'[1] failure to manage, operate and maintain the water facility. The literature shows that poor consumer willingness to manage water facilities is the major reason for unsustainability of rural water supply (Carter et al, 1999). The overarching question now is why this is the case when everyone including the consumer acknowledges the fact that "water is life". To the researcher lack of willingness to manage the water facilities is synonymous to low consumer perceived value received from these facilities, and this phenomenon emanates from customer satisfaction concepts.

Customer satisfaction is understood as a consumer's perceived value received from a product or service provider during his/her transactional or on-going relationships (Heskett et al., 1997) and can be an outcome or a process (Ying et al., 2009). According to Oliver (1997) the process oriented customer satisfaction examines whether the whole process of consumption experience achieves an expected result or not. This view looks at the entire consumption processes and finds a specific process that might lead to customer satisfaction. An outcome oriented consumer usually compares the performance or value of the product with their expectations of it.

The researcher has adopted both the satisfaction process oriented approach and the outcome oriented approach to conceptualise the entire research work; that is defining the specific process that leads to consumer satisfaction (in other ways understanding and managing the problem root causes of consumer dissatisfaction) in rural water supply which hypothetically is supposed to be an antecedent to consumer loyalty (Mittal et al., 1988); and

[1] Beneficiary, customer, consumer and end user are used interchangeably in the current research depending on context

that this loyalty should be displayed by behaviours essential for rural water supply sustainability. The researcher completes the process by looking at the water in terms of quality, quantity and its continuous availability, this motivates the consumer to own the water facility and take care of it.

## 1.1 Purpose of the Current Research

The researcher believes that the SDG #6 is fit to be a global minimum standard that should be applied to everyone-regardless of income quintile, gender, location, age or grouping and this is the direction of the whole purpose of the current research.

The current research is purposed to fill the existing knowledge gap on lack of practical models of approach that stimulate desired consumer behaviours for sustainability of rural water supply. This purpose will be achieved by developing a consumer satisfaction based practical model that both rural water supply service providers and communities themselves can adopt for provision of sustainable rural water supply. This is as a result of review of the extant literature that shows that no specific study has tackled issues of customer satisfaction in the rural water supply sector in Malawi.

## 1.2 The Problem Statement

About 663 million people still remain without access to safe water across the globe; and in many areas in sub Saharan Africa progress towards Millennium Development Goal (MDGs) was not continuous (WHO/UNICEF, 2008). In Malawi, almost 2.3 million people did not have access to safe drinking water in 2008 (Malawi Government, 2008) and the situation is worse when it is considered that about 24.3% of the Malawian population take more than 30 minutes to collect water.

The significance of such a big population spending many hours collecting water result in many lost economic hours. In the Malawi case considering the statistical overview presented in this thesis then almost 3.3 million hours[2] that could otherwise be spent unlocking potential – unlocking education, work opportunities and improved health for women, children and families in Malawi are lost every day collecting water.

As if the situation is not bad enough, almost 30% of safe water points are not functional at every point in time due to poor operation and maintenance (O&M) (Pritchard et al., 2007).

[2] *4.13 million Of the 17 million population of Malawi take more than 30 minutes to collect 20L bucket of water for the household; thus 826200 household women spending 4 hours a day collecting water.*

This translates to massive work that political leaders, academia, donors, governments, experts and researchers have to do in ensuring that all people have continuous access to safe and adequate water supply.

SDG #6 target 6.1 and 6.2 particularly tackle the problem of lack of access to safe drinking water as a global issue, in fact before SDGs the MDG target 7c aimed to halve the proportion of people without sustainable access to safe drinking water by 2015 (Cronin A., Breslin N., Gibson J., and Pedley S., 2006). According to the WHO/UNICEF JMP (2012) report, the challenge is tough in Sub Saharan Africa where many rural dwellers and the poor miss out on improved access to safe drinking water and sanitation, worse still it is in the same sub Saharan Africa where the burden of poor water supply falls most heavily on girls and women (Harvey et al., 2007).

Photo 2: Photo of women collecting water from unsafe water source in Ntcheu District in Malawi-photo taken 7/7/2016

Sub-Saharan Africa has the highest proportion of poor people in the world, with 63% of its population living in the rural areas (World Bank, 2013). The region has the world's fastest growing population with a 2.3% annual growth rate leading to increased pressure on various natural resources including water (Bordalo and Savva Bordalo, 2007). In fact about twenty two (22) African countries, including Malawi, fail to provide adequate and safe drinking water to almost half of their population (Pritchard et al., 2007) after considering non functionality of existing water systems.

SDG #6 on water and sanitation does not only look at solving the general access problem but also ensures that water sources are improved and sustainable. The objective is to ensure that the amount of time it takes to collect water is reduced, water quality is

acceptable and that people (including all Malawians) have sustained adequate water supply that would have meaningful impact in their lives.

The Malawi Population and Housing Census conducted in 2008, indicated that almost 2.3 million people in Malawi out of the total population of about 13.1 million that time, did not have access to safe drinking water as they drink from unprotected sources (Malawi Government, 2008). This situation overtime has not improved because the MDG end line survey (2014) indicates that almost 14% of Malawians do not have access to safe water. Meaning even after six years still around 2.4 million people still don't have access to safe drinking water in Malawi. This situation if not handled properly is very likely going to cause a huge disease burden as well as affect the social economic growth of the people of Malawi. This statistical situation is worsened when time taken to collect water is taken into consideration; about 24.3% of the Malawian population take more than 30 minutes to collect water in most commonly a 20 litters bucket (Mkandawire, 2008).

Table 1: Percent distribution of households and population by source of drinking water and time to obtain drinking water

| | | Households | | | Population | |
|---|---|---|---|---|---|---|
| Characteristics | Urban | Rural | Total | Urban | Rural | Total |
| **Source of drinking water** | | | | | | |
| % using any Non-improved source | 6.9 | 17.8 | 16.2 | 7.5 | 17.6 | 16.1 |
| % using any improved source of drinking water | 92.6 | 78.7 | 80.7 | 91.9 | 78.8 | 80.7 |
| Missing | 0.6 | 3.5 | 3.0 | 0.6 | 3.6 | 3.2 |
| **Time to obtain drinking water (round trip)** | | | | | | |
| Water on premises | 47.7 | 30.5 | 33.0 | 48.0 | 30.1 | 32.7 |
| Less than 30 minutes | 41.7 | 37.9 | 38.5 | 40.8 | 30.1 | 32.7 |
| 30 minutes or longer | 7.9 | 26.8 | 24.0 | 8.5 | 26.9 | 24.3 |
| Don't know | 2.7 | 4.8 | 4.5 | 2.7 | 4.7 | 4.4 |

Source: Malawi DHS 2012.

Access to improved water and sanitation is the cornerstone for healthy communities and plays a significant role for maintaining health, economic and social gains (Bartram et al., (2005); Hutton et al., (2007); Montgomery & Elimelech, (2007)). World Bank (2009) identified two major challenges for sustainability of rural water supply, one is the desire to continue to expand access and another is the high breakdown rate of water supply facilities; the latter is the focus of the current research. This is agreed to by Montgomery

et al., (2009) that a large percentage of non-functional water supply wells and unused latrines are the stark marker of poor operation and maintenance and that is proof of unsustainable services.

Several global studies have witnessed the unsustainable picture of rural water supply, especially in developing countries. Vanderslice and Briscoe (1993), mentioned that one in every four rural water supplies in developing countries do not work and that in some countries the construction of new facilities does not even keep pace with the failure of existing ones meaning a number of water and sanitation programmes in developing countries have not "continued to work overtime" (Carter et al., 1999). The primary reason for these high failure rates, and hence low sustainability, is insufficient attention to operation and maintenance of the pump (Harvey & Reed, 2004).

The tremendous investment in rural water supply during the decade had resulted, *inter alia*, in a tremendous increase in the number of broken down, poorly functioning, and little used water supply systems (Kleemeier, 2000) signifying lack of a sustainability focus in the investment. Carter (2005) reported that in Africa approximately 250000 hand pumps were installed, out of which only less than one half was operational. Water supply become non-operational within a few years of implementation and soon the next rehabilitation or water development project begins (Harvey & Reed, 2004).

The lack of functional water supply and sanitation services are alarming globally but worse in the developing world. The majority of the people who do not have access to improved drinking water supply; are from developing regions and most of them (84%) live in rural areas (WHO, 2010).

The impact of this challenge is very devastating, globally around 10% of total burden of diseases are related to unsafe water, sanitation and hygiene costing about 3.6 million lives annually (Pruss-Ustun et al., 2008). Economically World Bank (2008) estimates that the total effects of diarrheal diseases and associated malnutrition cost low income governments like Malawi up to 9% of their annual gross domestic product. At any moment, half of the developing world's population suffers from diseases associated in one way or the other with inadequate water supply and sanitation services and more than half of hospital beds in the world are filled with people suffering from water related diseases (WHO, 2009).

A study conducted by Mackintosh and Colvin (2003) in the Eastern Cape found that 70% of the boreholes were not functioning. Another survey conducted in 11 countries in Sub-Saharan Africa showed a range from 35-80% of water supply systems not functional in

rural areas (Sutton, 2004). Haysom (2006) surveyed 7000 wells and boreholes in Tanzania and found only 55% of those boreholes not in operation. Department of Public Health Engineering (DPHE) and JICA (2008), studied 120 village piped water supply schemes in Bangladesh to assess operational status of the systems, which showed only 48% of the schemes functioning during the survey, whereas, 13% and 39% were partially functional and non-functional respectively. Therefore, irrespective of technical options, non-functionality of a huge number of water supply systems fades the sustainability of the rural water supply.

Non functionality of improved water sources increases the threat to efforts towards universal water access as a human right. Many African individual country statistics on non-functionality of water points support this assertion. For instance, the percentage of non-functional water points in Tanzania and Swaziland is about 41%, 48% in Sierra Leone, 30% in Ghana 15% in Kenya and 40% in Liberia. In Malawi about 50% of water points are not working. These worrying statistics are referenced in various water mapping exercises that these countries carried out between the years of 2007 and 2012 (Matipwiri, 2013) and hence the challenge towards universal water access.

Considering this overwhelming water point non functionality pragmatic evidence and considering amount of resources most countries in Africa are investing in water access (UNICEF, 2006) including investments from governments, development partners and non-governmental organisations; it is clear that progress towards universal water access is being frustrated by water point non-functionality.

Although official figures show Malawi to have around 86% water supply coverage (MDG End line Survey, 2014), the number of people with reliable access is far lower. Many hand pumps are broken, leaving no choice but to go back to unsafe water sources. It has been estimated that on the average, one in three rural water facilities needs rehabilitation, and for a significant number of countries, the proportion increases to almost one in two water points as is found in Nigeria, Tanzania, Madagascar, Malawi, and the Democratic Republic of Congo (World Bank, 2010a).

To contribute towards achievement of the United Nations MDGs, Malawi's specific water policy objectives were developed to ensure that at least 80% of the population have access to potable water, and to reduce non-functional water-points from 31% to 25%, by 2011 (Malawi Government, 2008a). However after six years (2017) the situation is still the same, borehole non-functionality rates are still around 20-30% in fact according to data from section 4.4 of the current research only 49% of the boreholes had not experienced a

breakdown in past six months otherwise the remaining 51% of boreholes faced numerous breakdown challenges. The situation depicted in table (1) is still present in 2012 and the scenario of photo 2 is still common in 2016 (Ref Table 1 & Photo 2 of Chapter one) all after the delivery time specified in the Malawi water policy.

In Malawi, as in many developing countries, one of the major strategies to achieve these goals was to install protected water sources, such as boreholes and protected shallow wells, and this is in addition to rehabilitating non-functional ones (Wright et al., 2004). The Malawi strategy seems not to tackle issues of rural water sustainability from quality of service and customer satisfaction point of view as is done in urban setting but rather it focuses more on increasing access through construction of new infrastructure and rehabilitating of defunct water points (Malawi Government, 2008a).

Water points not functionality can be traced as far as 2005 and beyond when a published report on water point mapping in Malawi showed no progress at all as 40% of all water points installed were not operational (Wella, 2005). This is a big threat to achieving universal safe water access. The current water policy approach in Malawi can mean meeting water access targets but it is at the expense of its sustainability aspects. It is a point of concern to the researcher as it means nothing meeting MDGs targets in 2015 if by 2016 most of the water points built towards reaching this target will have fallen into disrepair as presented in photo 3 below:

Photo 3: Abandoned borehole in one of the research areas with broken bricks dumped on it

To a larger extent Carter (2005) and Harvey (2011) agrees that there is a problem with functional sustainability of rural water supply and the major cause is poor operation and maintenance. Montgomery et al., (2009) too confirm this fact by stating that the large percentage of non-functioning wells in sub Saharan Africa is a stark marker of inadequate operation and maintenance and lack of sustainability service. Actually Nieves (1980) precisely narrowed that down further to failure in capturing human interest as a contributing factor.

Previous studies identified the beneficiary who is the consumer as the most important character in management and operation of rural water facility (Montgomery et al., 2009; Carter, 2005). It is through this that consumer intentions and behaviours towards sustaining the water facility are coming out as vital for rural water supply. However literature fails to bring out triggers of this desired behaviour including what motivates the consumer to manage the facility.

It is this therefore time for sector practitioners, governments, researchers etc. (Montgomery et. al., (2009) to broaden their scope in coming up with practical promising practices that would improve sustainability of rural water supply by looking at stimulants of positive behaviour towards rural water supply sustainability.

According to Carter (2005) and Montgomery et al., (2009) research in rural water sustainability has not been exhaustive as it has failed to develop practical models of approach that implementing agencies, donors, funders, government etc. would utilise in order to achieve sustainability of rural water supplies. The current research fills that gap because the anticipated framework will be practical and readily easy to use. The current research is envisaged to capture consumer interest in sustaining the water supply system.

## 1.3 The Research Problem

Going through literature it is clear that many models have been developed with an assumption that consumers are responsible to sustain the rural water supply. Ironically even though with full acknowledgement that “water is life”, almost 30-40% of water points are broken down and not attended to. This situation necessitates an approach that will induce the desired behaviours from the consumer for sustainability of rural water supplies and that is the research problem of the current research:

*“The rural water supply consumer willingness to support sustainability of the rural water supply decreases with increase in consumer dissatisfaction and passage of time.*

In the commercial sector, literature has adequate evidence that customer satisfaction has the potential of stimulating customer positive intentions and behaviour on services and products (Oliver, 1999). This is an opportunity that can be borrowed and used in the rural water supply industry.

Using a process oriented approach for measuring satisfaction; the current research looks at how positive behaviour can be stimulated from a consumer satisfaction point of view. The current research will identify triggers for consumer satisfaction in rural water supply. This will enable the researcher determine how the triggers (later referred to as rural water supply sustainability pillars) impact consumer overall satisfaction in rural water supply in Malawi. The researcher will also analyse impact of consumer satisfaction as a stimulant of consumer behaviours in rural water supply.

The solution to the research problem has the following two major components;
1) Identifying the root causes of consumers' dissatisfaction and its significant impact on consumer positive behaviour for rural water supply sustainability.
2) Developing a framework for enhancing consumer satisfaction for functional sustainability of rural water supply.

## 1.4 Aims of the Current Research

The overall aims of the current research are to:

1) Identify the root causes of consumer dissatisfaction with borehole rural water supply systems.
2) Assess means of managing the root causes.
3) Develop a practical framework for stimulating desired consumer behaviour for improving functional sustainability of rural water supply.

## 1.5 Research Objectives

The overall aim of the current research is to provide a solution to the research problem by *"developing a practical framework for stimulating desired consumer behaviour for improving functional sustainability of rural water supply".*

This is systematically done by targeting and enhancing consumer satisfaction with a view of stimulating consumers' positive behaviour for functional sustainability of rural water facilities. The following objectives will be addressed in the process of attaining the aims of the current research:

1) To establish the role of consumer in rural water supply sustainability success;
2) To identify pillars of a sustainable rural water supply;
3) To establish factors behind rural water supply consumers' dissatisfaction or satisfaction;
4) To determine how the factors behind consumer dissatisfaction could be managed for sustainability of rural water supply
5) To develop a framework for enhancing consumer satisfaction with rural water supply in Malawi.

## 1.6 The Rationale of the Current Research

The most important aspects of a service to be sustainable are in two folds; 1) the users should be satisfied with the service (Argarwal and Rathod, 2006; Pinto and Slevin, 1994) and; 2) The service providers expectations should be realized (Al—Tmeemy, 2011). In Malawi 34% of consumers are dissatisfied with their water sources (Anscombe, 2011) and averagely 27.5% of boreholes are abandoned. These statistics coincidentally tally with the 30-40% non-functionality rates in literature meaning the larger the non-functionality rate the higher the chances of borehole abandonment. Anscombe (2011) tries to connect satisfaction and borehole functionality by suggesting that there is need to provide consumers with better products that satisfy them and increase their ownership of the facilities.

Low yield according to Anscombe (2011) is attributed to shallow drilling depth, poor borehole citing and wrong drilling method and has a bearing on consumer satisfaction suggesting that there exists reasons behind consumer dissatisfaction and that consumer dissatisfaction has consequences that may affect consumer willingness to support the water system. Anscombe (2011) suggest that when users are not motivated to repair their water points due to whatever reasons then it is these boreholes that tend to break down even more frequently. In fact Anscombe (2011) concludes that of the 30% of non-functional water points are due to unmotivated and unsatisfied users.

It is true that when people lack potable water due to broken down and unrepaired boreholes in rural communities, their freedoms and options become limited most often by poverty orchestrated by water borne/related illnesses. Also they become subject to other social and environmental disadvantages and vulnerabilities (Bartram, 2008; Pruss-Ustun, 2008; UNDP, 2006; Sachs, 2005). This fact justifies dissatisfaction of consumers when boreholes breakdown.

Issues surrounding failure to supply safe drinking water are too many and non-functionality of the facilities is just one of them. Literature overwhelmingly claims this to be as a result of lack of community participation and ownership. Community participation or management is an action or behaviour expected of the rural water consumer and it emanates from the consumer's intention to participate or manage. Issues of individual behaviour are complex as they differ from culture to culture. Because of these cultural differences research findings from one culture may not hold true in another culture (Moustahas, 1994) justifying relevance of contextualisation of the current research to Malawian context in a more specific manner.

In short, as noted by Skinner and others, the main recurring problems with rural water facilities are the lack of technical and financial capacity to maintain assets. This situation leads to rapid deterioration of rural water supply facilities to a point where they are no longer able to provide the intended service, and people reluctantly revert to surface water sources (World Bank, 2010a; Skinner, 2009; Mba and Kwankye, 2007).

The whole concept of comparing actual service to perceived service is what is referred to as satisfaction (Oliver, 1997). Satisfaction is not a strange terminology in marketing literature and many studies in marketing have attempted to predict customer's intention and behaviour with their products from a customer satisfaction point of view (Oliver, 1997). The current research borrows that approach and intends to analyse the consumers` level of acceptance and ownership including motivation to manage water facility from a consumer satisfaction point of view.

The emerging link between consumer satisfaction and willingness to sustain rural water supplies as presented by UNDP- WSP (2006) brings forth the need to analyse consumer satisfaction as an integral component of the formula for management of rural water supply. It is therefore important to understand its determinants and its measurable impact on rural water supply. The UNDP- WSP (2006) underscores the fact that consumers should be self-reliant by willing to give up their valued resources in exchange for a service. The researcher believes that the "how" question of this paradox can only be solved through a scientific research that systematically considers consumer satisfaction as a component of rural water supply sustainability.

According to Froehling (2008), overall satisfaction is the sum of different degrees of satisfaction of various aspects of the product. Thus different components of the product tend to vary in terms of their ability to impact overall satisfaction. This means in an event that consumer satisfaction is verified to be paramount for positive intentions and behaviour towards water supply sustainability; it will be possible to identify various components of a

water facility that significantly contribute to the overall satisfaction of a consumer (Anderson and Sullivan, 1993). This will enable the service providers to focus their level of effort in improving processes that evidently increase consumer satisfaction with rural water services there by justifying “value for money and effort” towards rural water supply functional sustainability.

## 1.7 Motivation for This Research

Montgomery et al. (2009) observed that countries like Malawi with poor levels of sustainability but high coverage of access to water, offer cause for concern because investments in the current infrastructure may be squandered by services that quickly fall into disrepair. Furthermore, the high proportion of the population reported to be served may dissuade donors from investing in these countries, when in fact, more resources, alongside a more sustainable focus for action, are required. Malawi in particular needs a “more sustainable focus for action” for the rural water supplies which can only happen through research work like the current.

According to Harvey (2008) the most common theme that has been laid out in poverty reduction strategy papers and national strategies for different countries for sustainability of water supplies is community management, yet it has failed to deliver satisfactory levels of sustainability meaning focusing on community management alone is not a solution to rural water supply sustainability. Researching on what underlies the human interest to efficiently and effectively operate and manage a water supply system in rural areas motivates the researcher to undertake the current research.

Functional sustainability has been a focus of many researchers in the water supply industry including being a focus of discussion during global UN forums (UN, 2003; Carter et al. 1999); researchers conclude that lack of sustainability is largely caused by poor community participation and public acceptance which affects continuous functionality of water supplies. This creates two painful scenarios for the researcher to reconcile; one scenario is where the consumer is well aware of the health benefits of using safe drinking water from protected sources and the other scenario is where the same consumer is not willing to sustain the safe water supply facility that sustains his or her life. Solving the circumstances surrounding this paradox motivates the researcher to carry out the current research and unearth the root causes.

A press release from UNICEF in New York on 22 March 2013 on world water day urged governments, civil society and ordinary citizens to remember that behind statistics are the

faces of children. According to UNICEF, globally, an estimated 2000 children under age of five die every day due to water related illnesses. Sanjay Wijesekera, the global head of UNICEF WASH programme said *"Sometimes we focus so much on the big number, that we fail to see human tragedies that underline each statistic. If 90 school buses filled with kindergartners were to crash every day, with no survivors, the world would take notice. But this is precisely what happens every single day because of poor water, sanitation and hygiene"*. According to the WHO/UNICEF JMP report (2012), 760,000 under-five aged children died in 2011 alone due to poor access to safe water; a figure that the researcher says is too big and a tragedy. These deaths of children especially in areas where safe water is not accessed because the water source is not functional are totally unacceptable to the researcher. It hurts the researcher when innocent children die from preventable diseases especially deaths that can be avoided through access and utilization of safe water; this motivates the researcher more to conduct the current research.

A policy report named "off track, on track" by Water Aid on progress towards 2015 MDGs on water and sanitation suggest and advocate for doubling global aid flows to water, sanitation and hygiene; that meant releasing an additional US$10 billion per year in the run up to 2015 and beyond (Wella, 2005). This investment would be heavily affected if functional sustainability of the water facilities will not be managed effectively and efficiently necessitating cutting edge solutions on water supplies sustainability now than latter. The advocated US$10 billion investment in the water sector is huge and it will be disappointing to see holes (boreholes) punched up everywhere on earth and yet not providing the safe water to the communities they were meant to serve because they are not functional. This motivates the researcher in finding solutions to this life threatening problem.

The researcher is motivated to understand elements or factors that significantly contribute to overall satisfaction of the rural water supply consumer to the point of motivating the consumer to positively behave towards sustainability of a water facility. The researcher is also motivated to establish the strength of the relationship between consumer satisfaction and functional sustainability of rural water supplies. The researcher understanding of the problem from a cognitive behavioural point of view assists in knowing that some kind of stimuli (external factor) that triggers a thought process in the consumer leads into a behaviour that can be instrumental in rural water sustainability and discovering that motivates the researcher to conduct the current research.

A further motivation is to contribute to the body of knowledge by developing a consumer satisfaction based framework for enhancing sustainability of rural water supplies thereby

filling in the gap that exist in literature; and that is the non-existence of a practice framework that stimulates positive consumer behaviours that are essential for sustainability of a water facility.

## 1.8 Research Methodology

The current research builds on existing marketing research on impact of satisfaction on consumer intentions and behaviour. It is conducted in the context of consumer –process-product relationship in the rural water supply industry. The current research uses a mixed methods approach by combining some aspects a quantitative and qualitative inquiry based on a pragmatist phenomenon.

Adoption of a mixed methods approach is very appropriate for the current research as it addresses the research questions without taking a predetermined stand (Feilzer, 2010). This is particularly true for impact of satisfaction on loyalty (Oliver, 1997). Satisfaction researchers have never developed an instrument that claims universal applicability rather satisfaction instruments have historically been created and validated for specified products, services, industries and companies (Oliver, 1997) meaning there is always room for flexibility when issues on satisfaction are being researched on, a stand usually adopted by pragmatists.

The researcher is not restricted by the research philosophical stand but rather is flexible to choose a particular stand depending on the nature of the research questions; purely of a pragmatist stand. In the current research; in order to best tackle some research questions a qualitative approach was adopted for those specific questions nevertheless other general qualitative questions were also asked on other research questions to help in the discussion stage only. Qualitative research explores attitudes, behaviour and experiences through such methods as interviews or focus groups. It attempts to get an in-depth opinion from participants as it is attitudes, behaviour and experiences which are important to best answer such research question (Strauss & Corbin, 1990).

The current research adopted focus group discussions and key informant interviews approach to tackle the research questions that required a qualitative approach. This was done in ten research case studies of borehole based rural water supply systems. Use of a multiple case study was adopted because it has many advantages over single case study. Yin (2003) explains that when the researcher chooses to do a multiple case study he is able to analyse the data within each situation and also across different situations unlike when a single case study is adopted. Another advantage of multiple case studies is that the

researcher studies multiple cases to understand the similarities and differences in the cases (Jack, 2008; Stake, 1995). In fact according to Baxter and Jack (2008) the evidence that is generated from a multiple case study is strong and reliable.

Saunders et al. (2007) argue that where possible reasons for a particular relationship is sought between variables and where the objective is to produce models of these relationships then survey strategy can be used. Survey strategy is usually associated with deductive approach which is the quantitative component of the current research. It is most frequently used to answer who, what, where, how many and how much questions which is in agreement with the research questions of the current research. Some research questions being exploratory in nature, it is accepted that surveys be used as a strategy for the quantitative data collection phase (Saunders et al, 2007).

Survey strategy often used structured questionnaires administered to a sample for data collection; the data allows for easy comparison (Saunders et al. 2007). According to Saunders et al. (2007) questionnaires are better at gathering subjective measures such as user satisfaction of the system being studied. The current research administered a structured questionnaire to water users in sampled areas across the country, the areas are called Area Development Programs (ADP) which are impact areas for World Vision International work, this was appropriate for the current research because the researcher had intended to make use of findings from the current research to influence future programming of World Vision in the sector.

Cross-sectional data collection time zone is adopted in the current research. This is adopted due to the time constraint nature of the current research. Previous cross sectional studies by their way of design could not empirically validate behaviour consequences of satisfaction. Instead, attitudinal loyalty was taken as a proxy for behaviour loyalty (See Bolton 1999 for an exception). Unlike other studies conducted on consumer behaviour, the current research will examine behaviour or practice and intentions for the past 12 months from the time of administering the questionnaire which renders a cross sectional study just as appropriate in determining link between consumer satisfaction and behaviour.

The current research will contribute to the understanding of impact of consumer satisfaction on sustainability of rural water supply systems by systematically mapping relationships between elements of a sustainable water supply into a practice framework that will help induce the desired consumer behaviour.

## 1.9 Research Focus and Boundaries

This section of the introduction chapter presents the research landscape by providing a brief overview of the research focus. Considering that sustainability is global and broad, this section gives the reader the right lenses of understanding the current research.

### 1.9.1 Positioning of the Thesis

The current research work focuses on establishing the extent various rural water supply sustainability factors impact consumers' overall satisfaction. It also establishes the extent consumers' overall satisfaction impacts functional sustainability of a water supply facility.

In the current research, critical satisfaction antecedents that impact on sustainability are identified and a scientifically accepted satisfaction based framework for managing rural water supply sustainability is developed. The current research will identify pillars of sustainable rural water systems; in the current research pillars are the fundamental principles for establishing a sustainable rural water supply. The fundamental principles are aimed to be practical and presented in a way that service providers can use in practice when rolling out rural water projects. Unsustainability state being experienced in Malawi is a result of failing sustainability pillars and the current research unearths the problems and proposes solutions for managing them. The current research also brings in the consumer satisfaction component in rural water sustainability. Consumer satisfaction is relatively new in the subject area but can help conducting rural water supply business differently. The researcher mission is simple "change the rural water supply end user from being a beneficiary to being a customer" and see how sustainable rural water supply is going to be.

The current research focuses on consumer satisfaction as an antecedent to appropriate intention and behaviour for managing rural water supply sustainability whilst holding other variables constant. It is possible that other moderating factors have an influence on behaviour of consumers like literacy levels, culture etc. but that has been presented as an area for further research. The current research is appropriate considering that satisfaction as a discipline is in its early stages of research in rural water supply in Malawi.

As many organizations especially governments and non-governmental organizations aspire to evolve into being better performing or impactful organization, consumer satisfaction is becoming a strategic focus of their business processes (Oliver, 1999). The current research creates that opportunity window of integrating consumer satisfaction as a business approach in rural water supply business processes.

### 1.9.2 Applicability of the Framework

The framework for enhancing consumer satisfaction in rural water supply approaches will address the subject of consumer satisfaction management in rural water supply. It will create an opportunity of strategic focus to service providers that are looking at improving consumer satisfaction as well as wanting to address rural water supply sustainability. Service providers will be able to priorities some specific components of rural water supply that are found to significantly improve consumer satisfaction and sustainability by using the current research framework there by attaining “value for money and effort”.

The framework is applicable to rural water supplies like boreholes, some elements of course including the general approach may be applicable to rural piped water systems and mechanized rural water systems that are community managed. The framework might not be wholesomely adopted for urban water supply as some components may not be appropriate for urban water supply.

### 1.9.3 Holistic Approach

The current research is guided by the unifying study done by Montgomery et al. (2009) that developed components for sustainability of rural water supplies. These sustainability pillars are identified through a deep analysis of literature. The identified pillars are individually tested to understand how they impact overall consumer satisfaction.

### 1.9.4 Thesis Structure

The current research followed a process that starts from formulation of research problem, goal and objectives to literature review, development of a hypothetical satisfaction rural water supply sustainability conceptual map and specific questions. The third chapter is on research methodology and sample selection; fourth, fifth and sixth chapters are on data analysis, presentation of findings, critical discussions, conclusion and framework development, then further research work.

Chapter two presents a critical review of literature on rural water sustainability, where an analysis of related works, recent development and challenges of rural water sustainability is done. Chapter two reviews various literatures on rural water supply sustainability in order to establish the practical aspects of sustainability which are referred to as pillars of a sustainable rural water supply. Literature has lots of terminology, models and frameworks which are very theoretical and difficult for a “development facilitator” to implement. Chapter two breaks down the literature through a descriptive analytical process. This section of the current research also discusses satisfaction as an antecedent to loyalty and behaviour of consumers. It presents a discussion on its relevance to rural water supply. A conceptual

map is developed based on literature review and research questions are formulated for the current research.

Chapter three provides arguments for selection of the research approach and method for data collection. A brief discussion of the research population is presented and a criterion for determining the sample is discussed.

Both qualitative and quantitative research findings are analysed and presented in chapter four. Using statistical package for social scientists, relationships between variables are established and presented. Through a thematic analysis specific themes that provide answers to research question are identified and analysed.

Chapter five discusses results that are presented in chapter four. In chapter five results are discussed and evaluated against current rural water sustainability and satisfaction literature presented in chapter two. This chapter is designed to assess if the five objectives of the current research have been achieved.

Conclusions to the current research are presented in chapter six and it is in chapter six where a framework of enhancing consumer satisfaction for functional sustainability of water supply is constructed. The framework is intended to define a systematic implementation process that enhances consumer satisfaction and consequently address issues around low sustainability of rural water supply. Contributions to the emerging discipline of rural water supply management is done with limitations outlined. Directions for further research are also presented as a growth area of satisfaction research in rural water supply.

Copies of the research questionnaire instruments are presented in appendices.

## 1.10 Conclusion

This chapter outlines the research problem, set objectives, scope and boundaries for the current research. It distinctively provides the relevant background to the research problem; delineate what is “in scope” and what is “out of scope”. This chapter provides the right lenses of understanding the current research landscape, and how goals and objectives are intended to be met.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Introduction and Overview

This chapter presents a critical review of literature on rural water supply and its thematic sustainability components. It provides the reader with an up-to-date account and discussion of the various research findings in rural water supply sustainability and customer satisfaction. It further discusses critical points of the current state of knowledge in rural water supply; it looks at various aspects of research including models and practices so far published in this field and provides their synthesis. This literature review generally seeks to present a summary of the important works done in this field of research, including its theoretical and methodological contributions. It is through this literature review that gaps identified and research are developed for the current research.

The introduction section of the literature review chapter introduces to the reader the most inspiring authors of the researcher. The introduced authors have extensively researched on rural water supply sustainability and argued on approaches key for sustainability of rural water supply which are a backbone of the current research.

The first section of the chapter concludes by reviewing the traditional approach of rural water supply for the reader to appreciate the current practice and its short falls. This section of the literature review chapter presents challenges of the traditional approach more specifically on operation and maintenance and connects it to the various initiatives taking place in the sector as a means to providing solutions to the problems.

The second section of the chapter focuses on sustainability; it starts by defining sustainability then presents specific studies on sustainable rural water supply sustainability. The later areas of this section of literature review chapter brings out issues affecting sustainability and sheds light on efforts being undertaken to solve those problems which includes frameworks and management models. This section of the literature review chapter assisted the researcher in identifying sustainability pillars/factors of a rural water supply thereby enabling the process of crafting the conceptual framework of the current research.

The third section of this chapter presents a critical review of a marketing subject “consumer satisfaction” and attempts to develop a broader picture of how focusing on consumer satisfaction can complement sustainability gaps in rural water supply i.e. “desired consumer behaviour”. Recent attempts on rural water sustainability, its challenges and direction are covered as well as recent findings about satisfaction. Core elements of satisfaction as a subject are explored as they serve as the hypothetical foundation of the current research.

The last part of this chapter brings forth reasons why current frameworks are failing to adequately address the sustainability problems as depicted by Montgomery et al., (2009). The conceptual framework has been developed from literature. Testing and analysis of the conceptual framework is systematically outlaid by first identifying the gaps and formulating related research questions that will later in the current research enable development of a consumer satisfaction based practice conceptual model for sustainability of rural water supply. This chapter ends with a summary of the findings of the literature review.

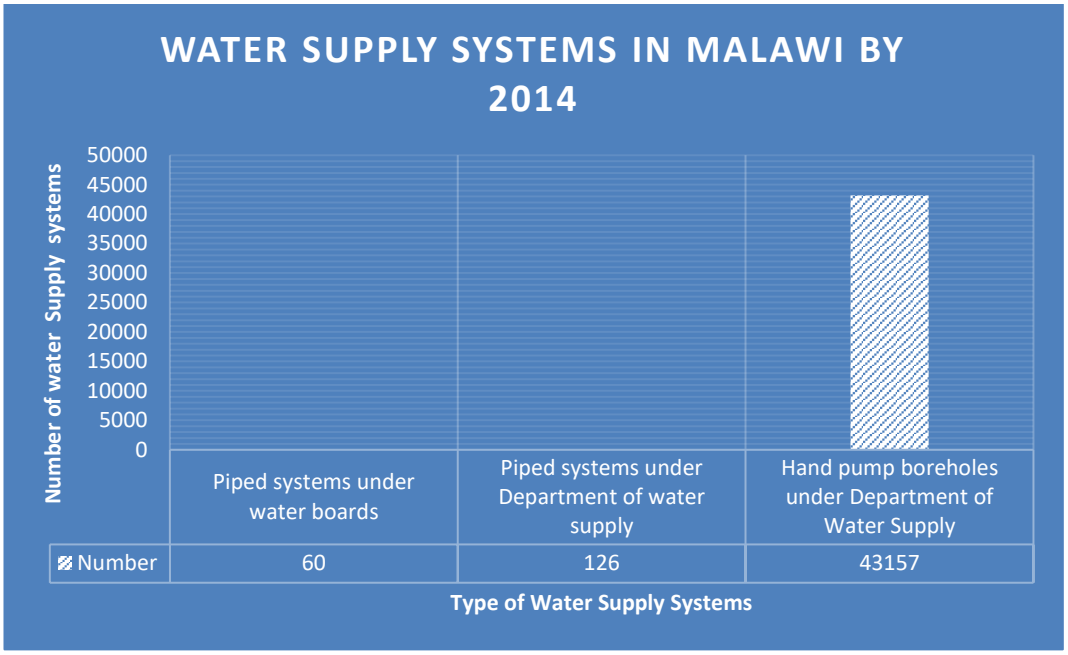
The main inspiring authors of the current research are Ungwe (2015) on sustainability of drinking water services in Malawi, and Montgomery, Bartram and Elimelechi who researched on increasing functional sustainability of water and sanitation supplies in rural sub Saharan Africa in 2009. These authors extensively researched in rural water supply and presented their findings which are essential for rural water supply sustainability. These authors/researchers discovered the foundational components of rural water supply sustainability; the authors also identified barriers to the components, and suggested feasible solutions for overcoming barriers within the context of rural Sub-Saharan Africa. According to Montgomery et al. (2009), dynamic operation and maintenance is the most critical component and yet it has largely been overlooked by researchers, providers, operators, and managers of water and sanitation supplies. Montgomery et al., (2009) encourage the research community of engineers and scientists and field practitioners to use the three sustainability components the authors found as a basis for rigorous inquiry into sustainability of water and sanitation supply. This is with a view that improving sustainability of water and sanitation supplies will result in salient and lasting gains in health and economic development throughout Sub-Saharan Africa.

## 2.2 The Traditional Approach of Providing Rural Water Supply

In order to understand issues that affect rural water supply, the current research first analyse the most common approach in rural water supply whose purpose has been to provide safe water in adequate quantities and of course within recommended distance.

The most common approach or the traditional way of providing safe water to people in the rural communities in Malawi from boreholes fitted with a hand pump:

Graph 1: Types and Numbers of Mostly used Improved Water sources in Malawi in 2014




Source: Ministry of Irrigation and Water Development (2014)

Graph 1 above demonstrates why specific research studies on hand pump boreholes need to be undertaken. From graph 1 above there are 43157 hand pump boreholes that are providing water to most rural communities in Malawi. By far hand pump boreholes outweigh piped water systems under Water boards and Department of water supply combined (186) as a source of potable water in Malawi justifying need for exhaustive research for sustainability of hand pump boreholes in Malawi.

The most recent research work in Malawi closest to the current research is about sustainable management of quality and quantity of drinking water services in Malawi by Ungwe (2015). The current research is similar to Ungwe`s work as both research are about sustainability of drinking water services, however the two research work are by far different because the current research is about boreholes whilst Ungwe`s research work is about piped water systems. The current research is generally conducted in rural communities whilst Ungwe`s research work is in semi urban to urban areas. The two systems also have different approaches of management and require different levels of capital for operation and management.

As per graph #1 above the predominant method of providing water to rural communities in Malawi is through boreholes fitted with hand pumps. There is further indication that boreholes currently serve an estimated 1.5 billion people globally, and has proved to have very high reliability if properly managed and maintained (MacDonald, 2005). Again, in Africa, about 250,000 boreholes with hand pumps are serving several rural communities. The current dependency level on boreholes by rural communities globally is estimated to be 75%. This evidence indicates that boreholes serve critical social and economic functions in rural communities which have far reaching benefits by reducing health hazards and improving economic and social opportunities (World Bank, 2010a; Bartram, 2008; Pruss-Ustum et al., 2008; Foster et al., 2006).

Malawi MDG on drinking water was that 74% of its population should have access to safe water by 2015 (Malawi Ministry of Irrigation and Water Development, 2010) whilst in a long term the target is guided by the Africa Water Vision for 2025 where Malawi set a target of 100% of her population accessing safe water by 2025 (Malawi Ministry of Irrigation and Water Development, 1994).

Governments support to the Rural Water Supply sector (RWS) has traditionally focused on designing and constructing water systems based on prescribed needs (UNDP-WSP, 2006). These needs are usually linked to perceived health improvements and give little consideration to demand for or sustainability of services (Pruss-Ustun et al., 2008). The traditional approach tends to pay more attention to building new facilities than to ensuring the sustainable use of existing ones.

With the traditional approach it is clear that some of the elements of sustainability like project planning, implementation, cost recovery, operations and maintenance (O&M), and asset ownership are poorly defined and communicated (Xu & Braune, 2010). In the traditional approach local users or communities are usually expected to provide a share of costs (mainly through in-kind contributions), it is often unclear how the level of contribution is determined or how the level of contribution relates to demand (Jime´nez & Pe´rez-Foguet, 2009b). The traditional approach frequently assumes that communities will somehow "manage" their facilities, but do not help build capacity or commitment to do so. In fact the traditional approach to rural water supply has frequently resulted in services that have not been sustained (Carter, 1999).

In fact, the management of boreholes by communities is meant specifically to empower and encourage community ownership to take full responsibility for boreholes sustenance. In that respect, community mobilization efforts are more often directed towards soliciting community involvement and inculcating a sense of responsibility and ownership. However,

this does not at all times stimulate the willingness required to accept immediate responsibility and voluntarily contribute funds for boreholes repairs and maintenance over the long haul. As such, several hundreds of boreholes become non-functional when challenges emerge relating to operation of the hand pumps (RWSN, 2010; Fosenka, 2008; Harvey and Reed, 2007). It should be noted that while community ownership does not in any way resolve the challenge of ensuring boreholes sustainability, it creates the avenue for social mobilization for communities to be passionate about the continual functioning of their boreholes and being prepared to take absolute responsibility (Schouten, 2006).

### 2.2.1 Issues Affecting Traditional Rural Water Supply Approaches

Literature review confirms that rural water supply is affected by many issues and amongst them is participation of the consumer in decision making and negotiation (Narayan, 1995). Concerted action related to water supply innovations is vital for sustainability of rural water supply (Narayan, 1995) and addressing issues that affect rural water supplies is critical as this inspire and motivate the consumer to increase their level of ownership and acceptance with the facilities (Mehta et al., 2005), leading to more sustainable rural water supplies.

The main issues affecting rural water supply are the dwindling functionality level of the water supply system, capacity of the water supply system to produce and supply adequate water, capacity of the water supply systems to produce safe water, quantity of available raw water and quality of available raw water (Ungwe, 2015). The more the product (safe water) is not available in adequate quantities the more consumers or users lose interest in contributing towards sustainability of the water supply service.

Rural water supply services especially boreholes are in different models with the understanding that these models will provide a sustained satisfactory service that would encourage a consumer contribute in various means towards sustainability of the water supply system. In the current research community managed model, private management model and private public operation management model are considered.

### 2.2.2 Community Management Model

The first and traditional approach of rural water supply projects generally adopts the community Management (CM) management model (Narkevic, 2005). The community management model has become a major subject in the design of rural water supply and sanitation projects throughout the developing world. The community management model emanates from many years of practice that considers community participation as vital for management of water and sanitation development projects, especially in rural sector (Harvey and Reed, 2007). The researcher presumption is community development model is failing to ensure sustainable rural water supply because the root causes of lack of

community participation are not identified and managed.

Over time different forms of community participation has evolved for rural water supply, the prominent model being community management service model (UNDP-WSP, 2006). Community management has achieved wide spread acceptance and majority of rural water supply and sanitation projects all over Sub-Saharan Africa are currently applying it (Ediriweera, 2005). Community management is evolved as an NGO- or donor-driven model for time-bound pilot projects (UNDP-WSP, 2006) This model may play under the leadership of government with community institutions to scale up the rural water supply delivery with the support from local and national government structures (Schouten & Moriarty, 2003).

Community management as a demand driven community-led approach incorporates participatory method and decentralization strategy to successfully deliver rural water supply services better than supply driven government-led models (Lockwood, 2004). It is argued that community management model can improve efficiency, meet the target of the project within planned budget and enhance sustainability of rural water management (Musonda, 2004).

The basic assumption of community management model is that beneficiary community is allowed to develop, own and operate and maintain their facilities or systems (Harvey & Reed, 2007) meaning any reason for failing to do that need to be sorted out. Additionally, it plays important roles during the planning and implementation phases (UNDP-WSP, 2006). According to Harvey & Reed (2007), development stages of community management for water supply are (I) Water committee formation; (ii) Training and capacity building; (iii) Setting and collecting water tariffs; (iv) Management and /or implementation of O&M activities of the system. The core values of community management are to empower and equip communities to take control of their own development (Ediriweera, 2005) of course the tough question remain “how do we equip and empower the consumer?”

However, community management model encounters a lot of challenges. First, it cannot work successfully due to absence of right configuration of markets, government institutions and tradition (Kleemeier, 2000). Second, a sticky problem with the volunteer based community management of water supply is that community-level committee and care taker lose their interests once trained individual moves away, and the community itself never take ownership of the new infrastructure (Carter et al., 2006). Here Carter et al (2006) is clear that despite it being a community management model but effective engagement, empowerment and involvement of the whole community is necessary in order to keep them motivated to sustain the water system or else the community will never own a facility and

the community will leave everything to a few individuals in the water point management committee.

Rural water supply projects that depend on community management model in developing countries face several threats (Lenton & Wright, 2004). For instance, dependency on community spirit becomes weaker with the modernizing influences such as increased mobility through infrastructure development, more off land employment access, industrialization, rural urban drift, increased wealth, materialism and individualism which erode the traditional structures and values. Moreover, bureaucracies of government structures in developing countries which are not suitable for community management approach (Carter et al., 1999) impede success of the community management model. It is therefore important to look at strategies that would curb impact of these challenges.

Management model is also fraught with different types of constraints-internal and external. Internal constraints include poverty, strong traditions, misplaced priorities and unfavourable settlement patterns within the rural milieu (Mackintosh & Colvin, 2003). External constraints noted are beyond the control of rural communities that include time constraints and sectoral development plans by External Support Agencies (Mackintosh & Colvin, 2003).

Community participation is identified as a tool for water and sanitation projects for short to medium term success (Carter et al., 2006). Doe and Khan (2004) recommended community management for smaller rural communities in which community will be involved actively. Community management model, albeit runs smoothly at the initial stage, problems begin within 1-3 years after the commissioning of systems leading to the breakdown of management system (Harvey & Reed, 2007). In addition, Harvey & Reed (2007), identified the causes for breaking of management system which are; dependency on voluntary input; lack of incentives for community members; absence of appropriate replacement policy for committee members; lack of transparency; accountability and lack of regulations; lack of legal status and authority of the water committee, absence of liaison with local government institutions, and inability to replace the major capital items. Most of the community managed water supply schemes run with acute financial shortage as this management cannot collect tariff from the beneficiary efficiently (Fonseca & Njiru, 2003).

Much as community management seems to be the most challenging model of approach but it has survived overtime with low levels of sustainability of course. Nevertheless as summarised by Kleemeier (2000) the problems of a community management approach are as below:

a) Challenge to predict funding from one year to the next. As a result it is very difficult to make even short term sector planning.
b) Poorer, dispersed, and less organized communities cannot address problems and in most of the cases follow up is minimal or less after construction.
c) Dramatic drop of management capacity of local water committee over the time as the people lose their interest, even though, initially members are trained extensively; no option for skill upgrading or members move away.
d) Spotty cost recovery for operation and maintenance; if too much raised the approach attract unscrupulous behaviour to use surplus; otherwise too little is collected which cannot meet the expenses of repair when needed.
e) For technologically complex system or large number of users, customer operation becomes challenging
f) Recuperation of investment cost stops once an upfront payment has been made
g) Scarcity of spare parts, trained manpower and tools/equipment for major repair resulting in the infrastructure sitting idle for long period of time.

It is also mentioned that in developed countries the community management model failed to manage rural water supply successfully, so it is not justified to expect breakthrough of community management in low income countries (Kyessi, 2005). As such this model has been demonized that it cannot ensure sustainability (Harvey & Reed, 2007) which is wrong. As challenged by Musonda (2004) developing countries adopted community management initiatives because this model removed internal differences, increased technical knowledge and management experiences.

The community management approach is found to be adaptable (Kariuki, & Schwartz, 2005). For instance, co-management with public agencies along with private firm immediately after implementation for 3-6 months made community capable of assuming the full management responsibility. This reveals that community management system works successfully if local capacity is adequately strengthened with external support prior to assumption of full community control of water supply systems, and if assumption of responsibilities is pursued gradually (Solo, 1999). In addition, capacity building, construction supervision and providing support to the community management during the first year of implementation are recommended for maintaining long term functionality of water points (Haysom, 2006).

### 2.2.3 Private Management Model

The second management model for rural water supply is the private management model. This model depends on private sector participation in the Water and Sanitation sector

for its success. Bakker (2008) identified six types of private sector participation arrangements as follows: (a) Service or management contract, (b) Lease, (c) Concession, (d) Build-Operate-Transfer (BOT), (e) Divesture and (f) Independent service providers.

Participation of private entity in the water sector is a growing issue. In private sector management approach, the private sector manages the system and communities pay for the service received (Harvey & Reed, 2004; Harvey & Reed, 2007; Parry-Jones et al., 2001).

The search for substitute of community management is a natural and growing response by the beneficiary communities and policy makers to improve rural water services. Relevant literature review illustrates that a wide range of private sector and public private partnership (PPP) initiatives are underway around the world (Kleemeier, 2000). In recent times private operators are involved in rural water supply in the form of delegated contracting through PPPs (Lockwood, 2004).

Carter et al. (2006), Doe and Khan (2004) and Harvey and Reed (2007) advocated for private sector participation in rural water supply sector. The authors underline the need for exploring private sector options in the rural water supply areas, in situations where there is resistance to community management or limited capacity for its successful operation. Musonda (2004) also supported private sector participation model as an alternative emerging management model for rural water supply. Musonda conceded on the fact that private management model is still in premature stage.

Fonseca et al., (2007) researched on factors that need to be taken into consideration for successful private sector participation, *vis a vis* providing reasonable profit for the service provider along with safe guarding consumers' or purchasers' proper rights, protection and choice.

Various researchers have also cautioned not to overestimate private sector's commitment to public service delivery as they lack sufficient skill and experience in the sector (Baumann et al., 2006). So capacity building of private sector is essential. The training focus should be on the pricing of service and goods, that water should be affordable to the community and agreement between consumers and service provider need to be fair and equitable (Franks & Cleaver, 2007).

Researchers also indicate the weakness of water entities as low community negotiation capacity and this can produce unequal contracts with private operator resulting in unequal competition where operator is likely to enjoy more benefit than consumers. Despite all

these facts, rural private operator model for water supply appears to be the promising option for solving the problems of sustainable operation and maintenance (Kleemeier, 2000). Ediriweera (2005) described merits of private sector management of water supply as a way of management which would reduce costs, opportunistic management and regulatory capture alongside increased investment, transparency and efficiency.

A number of researchers Wella (2005), Hall & Lobina, (2008), Barlow (2009), argue against private sector management that the profit motive of Private Corporation marginalize the poor. Without strong regulatory institution, privatization is inappropriate as adoption of incentives for externalities will harm the environment and result in less competition for contracts meaning private sector financing is costlier than public sector. Finally the strong argument against private management is that water cannot be treated as commodity, as access to water is human right (Jaglin, 2002). In addition, literature supports the assertion and opinion that private sector participation in water supply is geographically segmented. Specially, the low income areas are avoided globally, locally and regionally by private service provider (Montgomery & Elimelech, 2007). The reason behind it is simple as private service providers are in business and always want safe return of their investment.

Emerging trends appear that many governments of the developing countries are positively embracing increased involvement of the private sector both to financing and managing the industry's infrastructure and services (Narkevic, 2005). This is due to the growing political consensus that public sector is less capable than private sector to manage new or existing assets efficiently.

World Bank and the International Monetary Fund advocate for water service privatization on the assumption that private entities can improve the facility management since they are mostly ready to invest capital for infrastructure improvement, system performance improvement, and reduce water rates and be more responsive to consumer needs (World Bank, 2002). However, in some cases private water services are facing challenges because of much increase in water rates, economic fluctuation, decline of water quality and failure to expend the services to less profitable areas (Baumann, 2005). Additionally, water privatization in lower-income economies is problematic due to technological challenges, nature of the water supply product, transaction costs, and regulatory weaknesses (Water aid, 2009).

Sutton (2009), based on the study of Public-private partnership in water supply and sanitation conclude that though privately managed water supply programmes fail to meet its coverage targets, but are able to become financially solvent and can foster a rapid growth in capacity through the informal sector. Sutton (2009) also made some

recommendations on the basis of the experience of developing countries' water systems which favour private management of water supply. These are:

(I) Water vending and charging for water is common in developing countries and not culturally unacceptable.

(ii) To ensure sound management of water supply and sanitation services provision on incentives are essential.

In addition, roles of regulators are essential for public authorities to regulate the private supply activity and monitor quality of supply to maintain competition and ensure proper and fair operation (Kaliba, 2002). Billing, metering, maintenance of various components or tracking water losses are areas where partnership with the private sector is possible through contracting out. Private sector involvement offers better motivation and efficiency, except for poorer communities.

However even though the private management model requires an independent body to be managing a water supply facility, its efficiency depends on the community itself (Mara, 2003) as users are expected in the first place to decide who the water utility operator will be and not only that but also pay for the service. This means the consumers are still an important variable of the private management success formula including factors that fail them to take their respective roles appropriately.

### 2.2.4 Private-Public Operation & Maintenance (PPOM)

The other model of management incorporates both the public and the private sector, this approach has four key principles: water supply is owned by the user community; users finance operation and maintenance; the private sector ensures maintenance, repairs and functionality (Masdugi et al., 2007); and the public sector is responsible for private sector regulation and provides subsides. The PPOM can be rolled out in two formats namely; the total warranty scheme or the water assurance scheme.

***Total Warranty Scheme***

The hand pump manufacturer Vergnet piloted the Total Warranty concept in the 1990s on 75 water points in Mauritania, supporting and training local enterprises, with users paying an annual contract fee. The government role was one of regulation. After two years 60% the villages had paid and 20% had paid half (Wateraid, 2009). The cost recovery rate was low where systems were not operating suggesting that dissatisfied users are more likely to display behaviour that would not sustain the water facility.

***The Water Assurance Scheme (WAS)***

Although similar to the Total Warranty Scheme, WAS provides safe and accessible water regardless of the technology involved. Rural communities pay a monthly premium to a private company, regulated by local government. The company provides maintenance, water monitoring and repairs. WAS has been applied in Kenya and has considerable potential, especially where community management is ineffective.

***Private Ownership, Operation & Maintenance (POOM)***

Privately owned water systems have clear responsibility and incentive for O&M and can also be sustainable. This model attempts to highlight the fact that ownership, and operation and maintenance go together.

***Private ownership of water systems***

In Bugiri, Uganda, water has been collected from a privately owned borehole since the 1950s. It is repaired promptly since the owner makes no income when the pump is not working. Local households pay US$0.03 per 22 litres of water. This approach may have limited applicability but should not be dismissed out of hand. POOM is based on the following key principles; the water supply is owned privately; the user community pays the owner for water; and the public sector ensures price regulation. The simplest POOM model is when the water system is owned by an individual within the community. This role may also be performed by a private company.

***Hand pump Lease Concept***

In Lubango, Angola, the local water company owns hundreds of hand pumps, while the communities own the boreholes or wells on which they are installed. Each family pays the pump caretaker an affordable monthly amount, half for the pump caretaker's salary and half paid to the water company. Some hand pumps raise $240 per year, half of which goes to the water company. The average maintenance cost of only US$30 per hand pump per year, gives the water companies a healthy profit. POOM can be self-regulating, as water users will not pay excessive costs.

***Advantages over community management***

Alternative private sector management models have a number of advantages over the community management model but they are not always more effective. The choice depends

on the local context. For maximum sustainability, more than one approach should be considered.

Table 2: Advantages and Disadvantages of Various Options of Rural Water Supply Management Models.

| Option | Advantages | Disadvantages |
|---|---|---|
| VLOM<br>(Village Level Operation and Maintenance) | Fast initial response<br>Community control<br>Community pride | Needs motivation<br>Needs local skills/tools<br>Access to spare parts |
| PPOM<br>(Public-Private Operation and Maintenance) | Access to spare parts<br>Skills/resources provided<br>Community choice | Higher cost<br>Slower response times<br>Active regulation required |
| POOM<br>(Private Owned Operation and Maintenance) | Access to spare parts<br>Clear ownership/ responsibility<br>Skills/resources provided<br>Incentive for rapid repair | Lack of ownership<br>High initial cost to owner |

Regardless of the management model being used consumers are key for success of every model (Rogers & Hall, 2003). In literature above consumers are requested to contribute towards financing operation and maintenance. Apart from mentioning the desired behaviours from the consumer like willingness to contribute finances and other things none of these management models is explicitly laying out the approach that will stimulate the consumer in doing their part of sustainability success. The models demonstrate the intention to ensure that the service of providing safe water to the consumer is continuous and not disturbed for the design life period of the facility.

In summary, literature have three models; the Community Management Model, the Private Management Model and the Private Public Management Model. It is normal that models have advantage and disadvantages. Nevertheless literature has emphasized that sustainability is possible when local communities are strengthen and supported to be managers of their own development. Ownership and acceptance are a prerequisite for sustainability and community management model perfectly does that because the model

allows for community participation and involvement. If the challenges affecting community management model could be managed then community management model could be a simple approach with far more potential of ensuring sustainable rural water supply systems than the other models of approach.

## 2.3 Rural Water Supply Facility Management

Management of rural water supply and sanitation (WSS) systems is a major issue till date within the water sector (Lee & Floris, 2003). Actual number of people served by these facilities is often lower than uttered data as many of rural water facilities are inoperative or operating at reduced capacity. In most of the cases rural water supply management systems have failed to provide necessary guidance and structure for effective operation and maintenance (Sara & Katz, 1998) and that is the reason for numerous non-functioning water supply systems in rural areas.

The role of the consumer in management, operation and maintenance of water facilities is critical for sustainability of rural water projects benefits. Indeed, in fact operation and maintenance may be considered as synonymous to sustainability (Harvey & Skinner, 2002). Sustainable water scheme management integrates all the social, economic, cultural and political components of a scheme (Shaw, 2011). A number of studies also have found that the existence of a formal organization like water committee is necessary to manage the water systems' sustainability (Ramaswani, 2007).

External support, demand, social and collective needs, cultural institutions, economic and technological factors are identified in literature as vital for sustainable water management (Danert, 2009). Despite the long list Harvey & Reed (2006) however identified community management as the most underlying factor for sustainability of rural water supply.

Community management dominated the scene of rural water supply in developing countries for a long time. However despite its important role, it has failed to produce the desired results in terms of sustainability and functionality, and it is time to question the very nature of the management model instead of blaming practitioners and governments for poor implementation (Kleemeier, 2000).

Montgomery et al. (2009) present key sustainability components of rural water supply; these components harmonize different themes of sustainability that many researchers in rural water presented. These sustainability components are effective community demand, local financing and cost recovery and dynamic operation and maintenance in other words this is the ultimate desired community behaviour for functional sustainability of rural water supply.

Reviewing Montgomery et al., (2009) work on the above approaches or management models of rural water supply it is clear that the models made one common assumption; the consumer was assumed to be an active and motivated member of the community who is ready to display the desired characters and this often times is not the case.

The traditional approach also mixed the responsibilities of the community water committee with responsibilities of the community members themselves; unlike the water point committee who may have clear responsibilities but the consumer is only dictated on their roles (Arlosoroff et al., 1987. In order to develop a consumer satisfaction based model then it is important to establish the role of the consumer in rural water supply first. This will help in articulating the approach that can motivate them to effectively play their role.

The management models presented above have adequately presented the roles of the public sector, private sector and the community water point committee however it has not explicitly explained the role of the consumers or the community members themselves. In a bid to achieve sustainability from a consumer satisfaction point of view it is necessary that the role of the consumer and facts behind the consumers` failure to take up their roles are clear. This leads us to the first research question.

RQ1: What could be the role of the consumer in rural water supply facility sustainability?

## 2.4 Rural Water Supply Sustainability

The concept of sustainability is used in many contexts and with widely different meanings however the current research is on functional sustainability of water facilities and its benefits.

Sustainability today depends on communities taking financial responsibility for their schemes, which if achieved will enable scarce resources from government and donor agencies to be targeted specifically on areas where there is no improved water supply. The chances of achieving the Sustainable Development Goals without access to safe water by 2030 will be seriously lowered unless levels of sustainability can be greatly improved. (UNICEF & WHO, 2000; UNICEF, 2002).

Attempts to attain sustainable rural water supply can be traced a long time ago; Indeed, in the 1980s, local manufacture of hand pumps and associated spare parts had considerable potential to promote sustainability of rural water supplies from a spare parts availability point of view. This was thought by many to be a prerequisite for hand pump based water supplies (Whittington, 2008) and there was a big drive to promote in-country manufacture which

assured quality and accountability with a view that a properly maintained system would assure continuous flow of water for the consumer. This was one of the attempts to solve sustainability from a root cause point of view and suggesting solutions for managing the challenges.

The prevalent view over the past two decades indicates general acceptance that rural communities in developing countries should take full responsibility for the sustainable management of the water infrastructure investments made in their communities (World Bank, 2010b; Mays, 2007). By implication, communities should manage the operation, maintenance and repairs of all boreholes provided in their communities. This paradigm allocates responsibility for the continual operation of boreholes from government and donor agencies to rural communities (Burgi and Rydbeck, 2010; World Vision Ghana, 2003) before preparing them for the challenge.

### 2.4.1 Sustainability Defined

Literal meaning of sustainability is “to keep or maintain at the proper standard” in other words "Sustainable" means to endure, to last, and to keep in being. Sustainable development is about marshalling resources to ensure that some measure of human well-being is sustained over time. The objective is to take actions that will not impair future generations from living at least as well as the present or hopefully better (World Bank, 2005).

### 2.4.2 Rural Water Supply Sustainability Defined

Sustainability in water supply has been defined as the maintenance over time of water project benefits (Sara & Kats, 1998), it doesn’t matter who does what or where the support comes from. Sustainability has been a development issue since 1990s ( Bamberger & Cheema, 1990).

Researchers in water and sanitation sector have tried to define sustainability from different perspectives. In rural water supply, sustainability has been studied by various researchers shedding light on its different aspects and recommending for adoption some specific sustainability factors for supplying of safe water in the rural areas.

Sustainability is a very common word found in almost all the project proposal documents as an objective of any water supply and sanitation project. Shaw (2011) explained sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”. This explanation encompasses both the development and environmental dimension of sustainability. From these definitions it is clear that sustainability can also be specific for specific deliverables like water supply projects. Sustainability in this sense can be explained as the “ability of a rural water supply

development project to maintain or expand a flow of benefits at specified level for long period after project inputs have been ceased". A more simple and workable definition of sustainable water system was given long time ago by Sara and Katz (1998) that "a sustainable water supply system is the one that is able to provide an acceptable level of services all throughout the design period of the water supply system".

In a more simplified manner sustainability is simply whether or not something continues to work overtime. In water supply then it would mean water should continue to be available for the period for that it was designed, in the same quantity, and at the same quality as it was designed or better. Sustainability of rural water and sanitation projects can therefore be defined by their functionality; the system should function continuously and this can be achieved by maintaining both the physical and nonphysical components of the project active, and benefits should trickle down to the beneficiary level even after external support is stopped.

Harvey and Reed (2004) defines sustainable rural water supply by the state of its source. These authors explain that the water system is sustainable when "the water source is not over exploited but naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply, the benefits of the supply continue to be realized by all users over a prolonged period of time, and the service delivery process demonstrates a cost-effective use of resources that can be replicated".

A cursory look at the above mentioned definitions reveal several key issues of sustainability in water and sanitation sector as follows:

- Time: Product should provide benefits for its design life or even longer
- Quality: Quality should be maintained or improved
- Quantity: Quantity should be maintained or improved
- Benefits: Benefits should be enjoyed for the entire design life or even longer
- External support: Long term external support should be minimal
- Maintenance: Maintaining physical and nonphysical components active in order to keep the system functioning
- Source: The source should be protected for continual supply of water

Bearing in mind that the focus of the current research is on consumer satisfaction and its behavioural impacts in rural water supply management then sustainability can be defined as: The maintenance of an acceptable and satisfactory level of services throughout the design life of the water supply system. In this definition services are explained by functionality (frequency of break downs) and down time period (time taken to repair a

breakdown) of the water supply system. Sustainability should result in the ability of a facility to being consistently maintained and flow of benefits expanded at a specified and satisfactory level for the system design life or even longer period after it.

When assessing sustainability of boreholes in the current research, the term “sustainability" is used to imply how boreholes function over a period of time. Thus, when boreholes continue to produce water over a certain lifespan, at the same quality and quantity as at its inception, then it can be termed as being sustainable. This is on condition that the borehole has not been dysfunctional to warrant complete rehabilitation (Abrams, 2011; Fisher, 2011; Koestler and Koestler, 2008; Fosenka, 2008).

### 2.4.3 Studies on Sustainable Rural Water Supply

Having looked at the definitions and adopted a definition of sustainability for the current research it is important to review what other researchers have done in rural water sustainability most specifically for boreholes.

Water projects utilize three forms of capital (Carter, 2005). The role of the rural water project is to: (1) utilize water (natural capital) for healthful purposes (2) build water supply facilities (infrastructure capital) which pipe the water to convenient locations or through a system for use; and (3) operate and maintain the facilities through skilful management of human and financial capital. Each form of capital must endure in order to achieve sustainability.

The first form of capital largely depends on the source of water which can be an underground source or aquifer or a surface source like stream etc. (Harvey and Reed, 2004). Managing and protecting the source is key to keep the water flowing. The water shed or catchment needs to be protected, aquifers need to be recharged and the quality of water needs to be protected from contamination. Climate change can pose a threat to water resources in terms of rainfall which is a major source of recharge in most aquifers in Malawi as such it is paramount that issues of climate change be incorporated in rural water supply projects (Malawi Government, 2008a). In other words efficient conservation and utilization of water is critical for sustainability.

The second form of capital is the infrastructure itself and it comprises the type of technology preferred for example borehole, gravity fed piped water system, shallow well etc. According to Brikke & Bredero (2013) the type of technology adopted should take into consideration spare parts availability. The design of the actual infrastructure depends on a number of things; if it is a borehole then it includes the lithological structure, yield which all has a bearing on positions of installation of riser pipes and screens. The technical engineering

expertise on design of these water supply infrastructures is important in order to have a lasting facility that is capable to operate for its design life time without premature failure.

Whilst fully recognising the importance of the first two forms of capital for sustainability of rural water supplies *vis-a-vis* source of water and infrastructure, the third forms of capital are human and financial. The role of operational and maintenance through skilful management of human and financial capital is overwhelmingly mentioned in rural water supply sustainability studies as the most important element essential for sustainability (Carter & Rwamwanja, 2006). The willingness to efficiently manage a water facility and the skills to properly manage the facility rests on human capital and availability of funds which is financial capital.

Some decades ago, Sara and Katz (1998) explained sustainability in terms of three dimensional components namely technical, institutional and social.

***Technical Dimension***

Sara and Katz (1998) explained that technical issues relate to the design and construction of a rural water system and are the most obvious technical determinants of water system sustainability. Poor construction quality or the use of low-grade materials may lead to failure of the water system before the end of its design life (Busoga Trust, 2004). Similarly, design flaws with shallow wells, boreholes or other technologies, and over estimates of the water sources or aquifers may cause a system to fail from the outset.

***Institutional Dimension***

Even well-constructed water system needs proper institutional arrangements to keep it functioning over time (Abebaw et al., 2010). Almost every system require some sort of preventive maintenance; Hand-pumps may require greasing of moving parts; gravity systems may require sediments to be removed from storage tanks or repairs for leaky taps and cracked pipes, in addition, work is required to keep the water source free from contamination. This all requires some kind of an institutional arrangement that would be responsible for management of the water supply system (Carter et al., 1996). In most cases, the rural water systems are shared by a number of families, providing these inputs requires a community management structure, such as a water committee, to oversee operation and maintenance and collect money to cover costs of these services. An empowered and motivated community management structure is hence vital for sustainability.

***Social Dimension***

Sustainability of a rural water system is also presented by Mukherjee et al., (2002) to depend on the willingness of users to provide the necessary time, money and labour to keep the system functioning. This willingness may be affected by socio-economic factors such as income level, ethnic homogeneity, or the willingness of villagers to work together (Chambers, 1994). More commonly, however, the willingness will depend on how satisfied is the community with the service, usually compared to the previous water source in a community (Musonda, 2004). When communities perceive a significant improvement in water services, they are usually more willing to pay for operation and maintenance. According to Sara & Katz (1998) willingness-to-pay is also affected by community perceptions of ownership or sense of entitlement to free services from the government. Carter (2005) agrees with Sara & Katz (1998) from a user motivation perspective they say motivation is a critical social aspect of rural water supply sustainability.

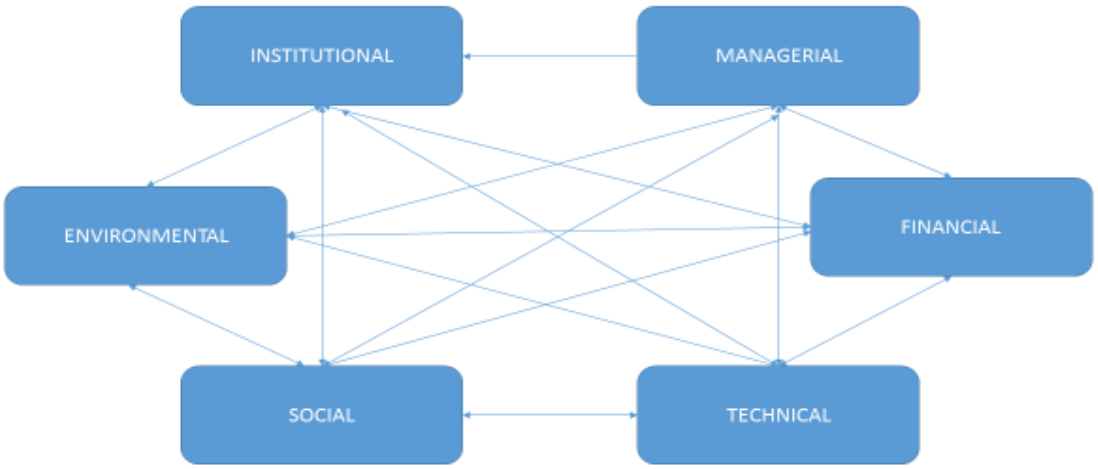
Sara & Katz (1998) just as supported by Doe & Khan, (2004) identified system design and construction quality as the most influential technical factor for sustainability. They also identified water committee, operation and maintenance of the system and money collection as vital institutional determinants of system sustainability. Socio-economic factors like income level, willingness of the users to allocate time, availability of adequate fund and labour are mentioned by both these researchers to be also essential in order to keep the system functioning.

Other researchers have described a sustainable rural water supply project as a system comprising of five dimensions namely institutional, social, technical, environmental and financial or economic (WELL, 1998).

Harvey & Reed (2004) identified eight sustainability factors. These are policy context, institutional arrangements, technology, natural environment, community and social aspects, financing and cost recovery, maintenance, training and capacity building.

Giné & Pérez-Foguet (2008) added a managerial dimension to the other sustainability factors; they also claim that institutional, social, technical, environmental, financial and managerial factors are interrelated as presented in Figure 1 below:

Figure 1. Factors Affecting Sustainability




Source: Giné & Pérez-Foguet (2008)

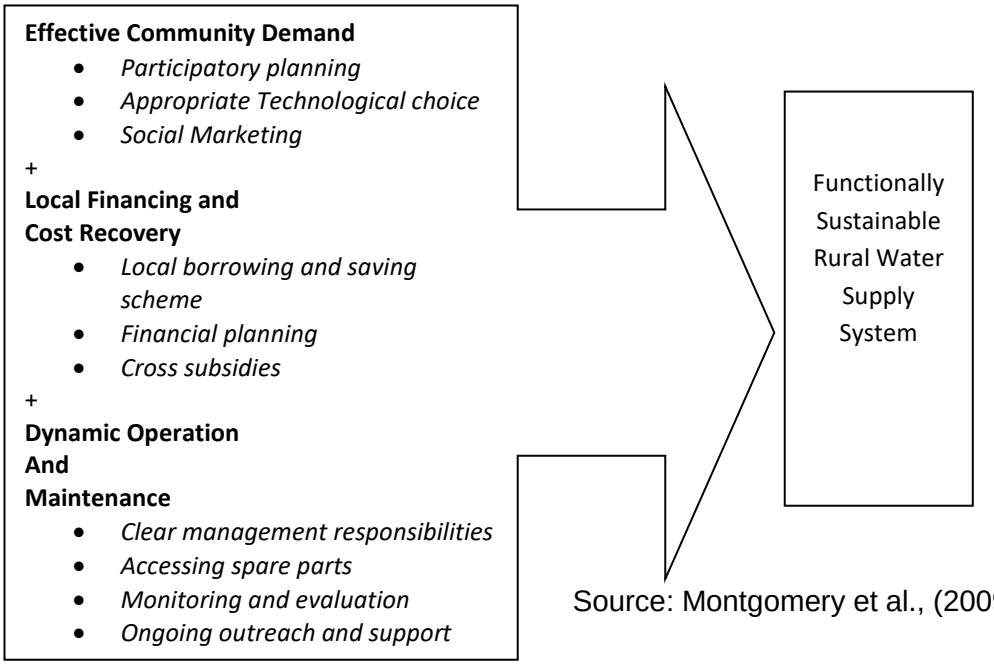
Other researchers like Carter (2005), Sara and Katz (1998) viewed sustainability from the factors that affect it whilst other researchers like Giné & Pérez-Foguet, 2008, Harvey & Reed (2004) classified the factors into categories as presented in figure 1 above. Just as factors are known to interact with each other the categories of factors that affect sustainability interact with each other too. It is therefore important to understand at this stage that just classifying factors into categories does nothing other than simplifying how sustainability can be viewed. The most important thing is to establish how these factors came into being to affect sustainability there by managing them from the root cause point of view.

### 2.4.4 Rural Water Supply Sustainability Frameworks

Effective community demand, local financing and cost recovery, and dynamic operational and maintenance are found to be part of the Montgomery framework for long term functioning of water and sanitation systems (Montgomery et al., 2009). These researchers recognise the fact that outcomes of a motivated community in rural water supply projects are a result of various initiatives and can lead to sustainability of rural water supply (see figure 2). They identified participatory planning, appropriate technological choice and social marketing as antecedents of effective community demand. Local financing and cost recovery is influenced by local borrowing and savings schemes, financial planning and cross-subsidies. Clear management responsibilities, accessible spare parts or technical expertise, monitoring and evaluation, and ongoing outreach and support are the enabling

factors for dynamic operation and maintenance. Montgomery et al., (2009) understanding of sustainability for rural water supply is provided in a diagram presented in figure 2 below:

Figure 2: Outcomes of Consumer Motivation in Rural Water Supply Projects




Source: Montgomery et al., (2009)

In figure 2 above, the outcomes of a motivated/inspired community is presented as a set of behaviours by Montgomery et al (2009). The first sustainability component is effective community demand, this component is the foundation for understanding and prioritizing community and household water and sanitation needs (Harvey & Reed, 2007). This component is fostered by a demand-responsive approach and related participatory planning methods that result in systems based on what individuals want, what they are willing to pay, and what they are able to sustain (Haysom, 2006). In contrast, supply driven approaches are often associated with a lack of funds for operation and maintenance, and may disproportionately benefit wealthier individuals who are better connected (politically and physically), and therefore, more likely to receive services (Jenkins and Sugden, 2006). Appropriate technology choice cultivates effective community demand by providing consumers with information about the potential water supply and sanitation solutions that consider local technical capacity and are suitable for local environmental, cultural, and economic conditions. Social marketing can serve as an important motivational tool in helping communities make informed choices (Jenkins & Scott, 2007).

The second outcome is local financing and cost recovery. This refers to local access to capital and savings (Montgomery et al., 2009). Communities experiencing this outcome looks from both within and outside for financing of their water needs. Water and sanitation needs have not typically been included in the suite of local financing investments. Often the

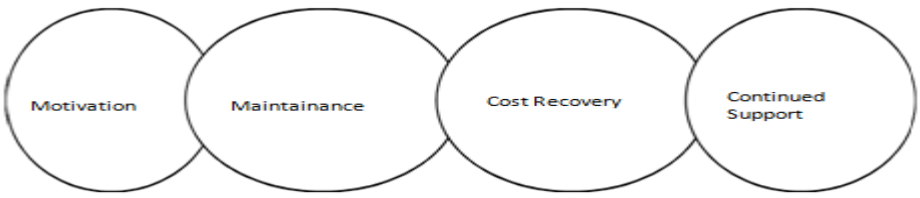
borrower (communities and/or households) cannot meet initial loan requirements, and the period for loan repayment is significantly longer compared to that of other sectors. Recently, however, local financing approaches that allow for lenient repayment periods, permit nonmonetary collateral, and are linked to business development have become available to some rural communities (Fonseca et al., 2007). This second component also includes strategic financial planning and revenue collection, as well as intra-community cross-subsidies to allow for equitable access to services (Harvey & Reed, 2004).

Finally, dynamic operation and maintenance is based on clear benchmarks of performance that allows for adaptations in hardware and software based on changing technologies, user demand, and economics. This component relies on establishing clear responsibilities that may be held by the community, an external provider, or through a collaborative arrangement (Harvey & Reed, 2007). Dynamic operation and maintenance management also includes establishing supply chains, conducting monitoring and evaluation, and collaborating with internal and external organizations for ongoing technical training and support, as well as hygiene and sanitation advocacy (Harvey and Reed, 2004; McConville and Mihelcic, 2007).

According to Well (1998), for a water supply programme design to be sustainable, four success criteria need to be considered. These are effectiveness, equity, efficiency and replicability. Meaning, to achieve sustainable scheme management structure, social, economic, technical, institutional and environmental factors of rural water supply need to be attested to this criterion.

Sustainability can also be presented as a dynamic mechanism for instance Carter et al., (2006) proposed a sustainability chain consisting of four essential components (Figure 3). The missing of any one of these may endanger the sustainability of whole system.

Figure 3. The Sustainability Chain




Source: Carter et al., (2006)

In this sustainability chain above (Figure 3) Carter et al., (2006) argues that community motivation encourages community to utilize and manage the new service. Appropriate motivational activities assist benefiting community in becoming aware of the benefits of the new service source by comparing it to the previous water service. This may be in terms of access, or proximity and safety. Carter et al., (2006) also argue that motivation, value, worthiness, self-interest are required for all stakeholders including consumers for them to take an active role in the sustainability chain. It is imperative that water facility management committee, caretakers, public and private sector and all other stakeholders involved in rural water supply service provision are fully participating in delivery of high quality services. Health education, community involvement and community ownership are regarded as harmonious to community motivation. In fact Carter et al., (2006) underline the fact that sustainability starts with a motivated and an inspired community of users.

The maintenance stage in the sustainability chain for water supply system depends on the nature and type of technology. By and large, for all types of technology a clearly structured, resourced and trained maintenance organization is essential. For community management systems, committee appoint caretaker for maintenance. But most of the cases, they need help from backstopping agency like government or NGOs. So, the communication line between community and backstopping agency is vital in order to lower down maintenance response time and water facility down time.

Cost recovery is an important issue for financial sustainability of any scheme. Cost recovery need also to cover for staffing, training, transport, spare parts, materials, tools, and replacement of units. It is necessary to fix up the cost recovery mechanism as the basis of user payments and a means of administering and accounting for water charges by the community (Montgomery et al., 2009). Better cost recovery can ensure sustainability of schemes.

In developing countries water and sanitation facilities work long time if service is managed jointly by community and external support agencies (Carter, 2005). So it is essential to deploy government agencies or NGOs for follow-up support. In support of this fact, (Danida, 2007) have also acknowledged external support as the vital factor which affects sustainability of water supply.

Sustainability can also be presented into two phases of service. The first phase is the initiation phase and the other phase is the ongoing phase (Ediriweera, 2005). The initiation phase is the establishment phase of service; it covers planning, design and construction of service, establishment of the institutional framework and initial commissioning. The ongoing phase covers the rest of service life. It involves

operating the service to satisfaction of the consumer, collecting revenue, maintenance of the infrastructure, administration and all the day to day activities.

Probability of things going wrong is more in ongoing phase. Gine & Pe´rez-Foguet (2008) suggest that there are some activities which may promote sustainability with respect to both initiation and continuation phase. For initiation phase sustainability, issues like demand driven development, capacity building, community awareness, project initiation and development of key performance indicators are worth-mentioning as critical issues. But by contrast, very little thought has been put in place for continuation phase. The continuation phase sustainability is heavily contingent on the institutional arrangement of local government, District councils, Provincial Government and the National Government. It is therefore vital to establish institutional support system which has the capacity to perform their function to survive and deliver real service to consumer.

Research on financial sustainability of rural water systems identifies water tariff and willingness to pay as major factors responsible for sustainability of the scheme (Fonseca & Njiru, 2003). These researchers claim that village size influences sustainability of the scheme. Willingness to pay is found working better for improved services like house connection in preference to public faucets (Cleaver et al., 2005). Household income and wealth, family size, education, and dissatisfaction with traditional water sources positively influence willingness to pay resulting in increased sustainability of the scheme. Similar study on operational sustainability of water supply systems carried out by Bhandari & Grant (2007) also found that satisfaction, trust worthiness of the water-user committee, affordability of user and willingness to pay are the most important operational sustainability factors.

Sustainable water projects are those that follow an approach with regular cycle of activities like planning and design, start-up, implementation, phase-out, and finally, project completion (Gross et al., 2000). The project regular cycle approach produces benefits which continue at some level over time. Post-project assessments of sustainability take place after a project is completed to allow the local institutions time to become self-reliant. Assessments should be carried out several years after the end of the project (Harvey, 2008) for a valid judgment as to the direction of the benefit stream and an assessment of sustainability.

In support of the project regular cycle approach, McConville & Mihelcic (2007) evaluate water supply projects sustainability by dividing them into the following five sequential stages: (1) needs assessment, (2) conceptual design, (3) design and action planning, (4)

implementation, and (5) operation and maintenance. Each stage is represented as an element in a sustainability matrix and scored according to specific guidelines.

A team of United Nations Development Program (UNDP) and World Bank specialists offer another approach to determining sustainability using qualitative and quantitative measures. The UNDP team conducted research in 16 countries in Sub-Saharan Africa and found that the measure that improved rural sustainability in nearly all countries was operation and maintenance. Specifically, the study highlighted the importance of establishing reliable spare part supply chains, training skilled technicians to repair wells and latrines, and providing ongoing technical and management support (UNDP-WSP, 2006).

Self-supply of water for individual households and small groups who can afford is important for sustainability (Lockwood, 2004) as a compliment to community supplies and a means to achieve sustainable services. The main aspects of self-supply are the promotion of enabling policies, provision of information regarding various water supply and treatment technologies, and development of maintenance and management skills to households and communities that wish to invest in their own supplies (Musonda, 2004). In this regard self-supply allows communities to choose the technology and conduct progressive upgrading with little outside investment.

After reviewing various literatures regarding rural water supply it is clear that the most important character in rural water supply sustainability is the water facility owner or user; in other words the users have the responsibility to ensure ongoing sustainability or even upgrading of the water facility (DWD, 2000b). The users should be motivated and be willing to operate, maintain, manage the water facility through various means whether it is contribution in cash or kind, time, actual participation in operation and maintenance activities, outsourcing, sharing of ideas, providing security, ensuring that proper hygiene and sanitation is maintained, protecting the catchment etc. (Hazelton, 2000). It is therefore a responsibility of the service provider to ensure that users are motivated enough to display appropriate behaviours that are essential for sustainability.

Scholars in the field of rural water supply have developed models, theories and best practice for sustainable rural water supply. Others have presented their models as systems comprising of a cycle of activities, chains, some have presented sustainability frameworks for rural water supply in form of elements or parts of the whole framework while others present them as sustainability best practices (Harvey & Reed, 2004). However despite rigorous work about rural water supply sustainability, there still lacks a concise, practical basis for improving sustainability of rural water (Montgomery et al., 2009). Regardless of what kind of framework but consumer ownership and acceptance that leads to dynamic

management for operation and maintenance of the facility is highlighted as critical factor for sustainability (Bhandari & Grant, 2007).

Various models of approach attempt to provide solutions to issues affecting operation, maintenance and management of the water system or facility with a view of making the water supply system sustainable.

In reference to literature presented in section 2.5.1 to 2.5.4 of this chapter; it is clear that a sustainable rural water supply system is beyond the sustainability themes or dimensions mentioned in frameworks discussed above rather it is dependent on some practical sustainability pillars that can ably be put into implementation (Hossain & Shah, 2006) and are named in the current research as “sustainability pillars”. These pillars are not coming out clearly from the existing frameworks rather what is coming out are the themes, factors or dimensions which are difficult to implement, this revelation necessitates a process of analysing literature, identify the pillars and packaging them for use. This process of identifying practical sustainability pillars is important in the current research because it is a platform for developing a practical framework which can be used to solve rural water sustainability problems thereby leading the researcher to the second research question:

RQ2: What could be the pillars of a sustainable rural water supply?

## 2.5 Challenges Hindering Attainment of a Sustainable Rural Water Supply System

Although the need for water and sanitation services is widespread, local demand for such services, especially given the large number of pressing development needs in rural communities, is not well documented (Montgomery et al., 2009). One reason for this is that community articulation of demand requires a facilitation process, which is hindered by expansive physical distances and a lack of road and telecommunication infrastructure in rural areas. This prevents regular communication between water and sanitation providers and communities that desire support (Harvey & Reed, 2004). In addition, effective community demand may be eroded by internal and external pressures felt by both service providers and communities to quickly construct infrastructure (Jenkins & Sugden, 2006). This may lead to conducting perfunctory demand assessments that do not allow for prioritization of needs or local empowerment.

Insufficient post construction communication and support is also problematic (Carter et al., 2006). Few funding or monitoring incentives exist for external water and sanitation partners to maintain regular contact with, and offer support to communities once projects are

completed. Furthermore, there is often not systematic documentation of failed schemes or consequences for providers who invest in, and are at least partially responsible for, poorly functioning or unsustainable water and sanitation systems.

The lack of financing services and cases of misappropriation of water user fees pose considerable challenges to local financing and cost recovery (Frances & Gerlach, 2008). Only 6% of families in Sub-Saharan Africa have access to banking and financing services (Harris, 2002). Where there are such institutions, many individuals do not apply for loans due to a lack of collateral or information, and those that do often face a web of bureaucracy and restrictions that prevent prompt deposit and withdrawal of funds (Sutton, 2009). Consequently, communities may resort to keeping water user fees and community collections in pre-established general village accounts or even entrusting them to individuals. Although water and sanitation accounts are not impervious to misuse, the transparency associated with formally established funds provides safeguards and encourages rather than dissuades users from contributing to current or future water and sanitation activities (Haysom, 2006).

Insufficient financial planning and lack of spare part suppliers are two major barriers to dynamic operation and maintenance (Harvey and Reed, 2004) this means managers of rural systems without sufficient know-how and training may grossly underestimate recurrent and future costs. This can result in unreliable service and inefficient use of initial investments. The importance of fully accounting for operation and maintenance costs was highlighted in a comprehensive global cost benefit analysis. The analysis concluded that funding needs for maintaining current water and sanitation systems are three times greater than the amount required to extend coverage to new areas (Hutton & Bartram, 2008). The lack of easily accessible replacements for commonly broken well and pump components in rural areas compounds the problem of insufficient financial planning, and results in straightforward repairs requiring weeks or months to complete (Oyo, 2006; UNDP-WSP, 2006).

An elaborate literature review conducted by Lockwood (2004) reveal critical issues affecting rural water supply sustainability; Lockwood (2004) categorises the issues into two phases namely pre-project and post-project issues as presented into table 3 below:

Table 3: Critical Issues of Sustainability in Different Project Phases (Lockwood, 2004)

| Pre-project issues | Post-project issues |
|---|---|
| Community participation | Finance and tariff collection |
| Demand responsiveness | User satisfaction |
| Capacity of water committee | Definition of rules for system management |
| Construction quality | On-going training |
| Gender and poverty focus Training | |

In addition to the above issues affecting sustainability by Lockwood (2004) other researchers in the water sector have mentioned supply chain for spare parts as another issue affecting rural water supply sustainability (Hunter et al., 2010).

Spare Parts Supply Chains and Related Issues

A major challenge for sustainable rural water services is the provision of equipment and components for operation and maintenance (Carter, 2005). Attempts to encourage private sector supply chains have had limited success due to low commercial viability (Sutton, 2009).

In Traditional Authority Nankumba, Mangochi, Malawi, the district water and sanitation committee with assistance from Icelandic government development agency established a private spare parts supplier network. They stocked local hardware stores with borehole spare parts and provided them with some seed fund. This initiative eventually failed as the owner did not use money from sales to replenish stock, due to low turnover and profitability. The district committee itself now supplies spares to communities (Matipwiri, 2013).

According to the evaluation report of the water and sanitation project in Traditional authority Nankumba (Matipwiri, 2013) the density of water systems in rural areas is low, so private sector supply chains will be unsustainable unless at least one of the following criteria is met:

- spares supply is linked to the supply of pumps and related services;
- community managed maintenance is replaced with centralized public-private systems; or
- technologies use available 'standard' spares

If none of these are fulfilled, alternative strategies for spares supply must be adopted which means understanding the other procurement processes and services linkages.

Procurement and Service Linkages

Strengthening links between pumps, services and parts can increase the viability of supply chains (Sutton, 2004). Procurement practice of donors has a major influence and can stipulate roles and responsibilities of manufacturers within contracts (WSP, 2009) thereby establishing a viable system for access to spare parts. This can also mean selecting pump suppliers locally who can provide spares and services rather than international suppliers who offer the lowest bid price. Government decentralization policies can also encourage local procurement of pumps and services, stimulating supply chains down to district level (World Bank, 2006). However this approach may have limited viability and may not increase accessibility to spares in sparsely populated areas with poor transport routes.

Public–Private Maintenance Systems

It has also been argued by Carter (2005) that Village Level Operation and Maintenance (VLOM) creates unreasonable demands on supply chains. Carter (2005) says that Public-Private Operation and Maintenance (PPOM) reduces this effect considerably as spares outlets are needed only in larger regional settlements for private service providers with greater mobility than rural communities. The application of this approach may be limited by the density of communities served and the willingness of users to pay for services and private sector capacity.

Appropriate Technology

Other researchers (Musonda, 2004; Lee et al., 2003) say that the simplest solution is to use technologies which do not require specialist spare components, such as the Rope pump, Bucket pump and locally developed pumps such as the Bush pump or AFRI-pump. It is simple because spares can be found in the average rural hardware store or that spares can be made locally and that tools could be widely available. A study by International Development Enterprises in Bangladesh showed that the rural poor prefer cheaper technologies in spite of the need to repair or replace them more frequently. This suggests that the argument for high quality technology and parts may be externally driven rather than demand responsive (Carter, 2005).

Subsidies

Many supply chains are subsidized and it is important to assess their sustainability. External donor or agency subsidies are likely to be unsustainable, requiring phasing out or transfer strategies. Government or indigenous private or non-profit sector subsidies are the most sustainable option when a pure business approach is not possible (World Bank, 2002).

Private-sector sponsorship has not been tried on a large scale. With this approach a company may pay advertising fees directly to the spares retailers to promote spares outlets, or a large company might add spare parts to its product list and advertise its support of rural water supply.

Spares provision by non-profit-making organizations may be preferable. In Malawi the Presbyterian Church an indigenous religious organizations with a reliable funding base have done this successfully for up to 20 years. Although coverage is limited by the number of appropriate organizations, it should not automatically be dismissed as unsustainable (ODI, 2004).

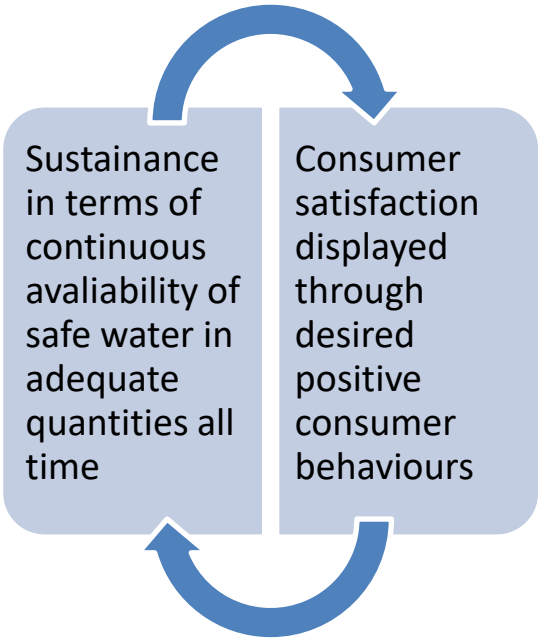
All these issues affecting rural water supply spare parts access have an impact on its sustainability and are part of the current research. In an attempt to better understand sustainability the researcher commenced by looking at its definitions and concludes by packaging motivational activities essential for triggering positive user behaviour that is appropriate for rural water supply sustainability. In other words the researcher attempts to understand the impact that motivational activities have on the consumer and how that translates to sustainability as is presented in the sustainability chain by Shaw (2011).

Section 2.6 of this chapter clearly points to the most important aspect of sustainability failure and that is failure to solve the root causes. Montgomery et al (2009) is trying to say that despite the many frameworks that exists but rural water supply remains to be a challenge because the roots behind the framework failure is not solved. There is need for a systematic approach of handling sustainability challenges for rural water supply other than bag punching hoping one day the rural water supply system will respond and turn to be sustainable.

### 2.5.1 Overcoming the Challenges: A Social Perspective

For rural water supply systems like boreholes that rely on the consumer willingness to support sustainability of the water supply system then it's a chicken and egg scenario. Develop a rural water system that will satisfy the needs of the consumer or user and in return will play their role support for sustaining the water supply system.

Figure 4: Rural Water Supply Service Quality Performance and Consumer Behaviour Relationship




Source: The Author

Figure 4 presents the relationship that will come in force when the service quality performance indicators of continuous availability of safe water in adequate quantities is attained. The envisaged high levels of service level performance will trigger satisfaction in the consumer and the outcome will be a display of Montgomery et al., (2009) outcome behaviours and that will result in sustainability of the water system. A sustainable system will motivate the consumer to ensure sustenance of the service level indicators is maintained there by ending in a cycle of sustainability actions and outcomes that would ensure sustainability for a long period of time.

### 2.5.2 Overcoming the Challenges: A Business Perspective

Measurement and analysis of satisfaction has received increased research focus in various disciplines, including economics, public administration, psychology, and marketing. As indicated by Deichmann & Lall (2007), satisfaction can be modelled as a function of (1) citizens' prior anticipation of the performance of a product or service, and (2) the actual performance, as perceived by them. In other ways expectation serves as an anchor to the evaluation of performance (Deichmann & Lall, 2007).

In applied research, measuring satisfaction with services is a difficult task (Jones et al., 1995). However, it is assumed to be potentially related to personal and economic characteristics such as age, gender, education, income, and wealth. Previous studies in economics indicate that women and older people have greater levels of satisfaction but that

satisfaction levels strongly decline as the level of education increases (Bhandari & Grant, 2007).

Empirical studies of client satisfaction with public service delivery have received increased attention in recent years. For example, Deichmann & Lall (2007), finding that citizen satisfaction with urban services is closely associated with the actual performance of the services versus citizens' initial expectations about these services.

Satisfaction as an Instrument to Influence Consumer Behaviour

The process of developing a water supply facility is both software and hardware (Thorsten, 2007). As the consumer is provided with this product; the consumer evaluates both the software and hardware attributes (Olsen et al., 2003) of the facility which determines their satisfaction status with the product. Satisfaction status may not only signify their level of acceptance and ownership of the facility but also their motivation to manage the facility (Deichmann & Lall, 2007). Understanding what influences consumer behaviour (Mittal & Kamakura, 2001) towards ensuring functional sustainability is cardinal in understanding facts behind sustainability of water supplies. It is imperative to explain consumer behaviour when justifying approaches taken for provision of these services to the consumer.

The theory of reasoned action and the theory of planned behaviour (Quick, 2003) assert that behaviour is a function of behaviour intention and that positive intention should result in positive action or else there is going to be a dissonance if they do not meet their commitment.

A significant amount of research has been conducted to understand the antecedents and outcomes of consumer satisfaction. Although number of studies on the topic is impressive; Szymanski & Henard (2001) in their meta-analysis ironically say that very few outcomes of satisfaction have been investigated. The outcomes that have received significant scholar attention include purchase intention, loyalty, word of mouth advertising and complaining behaviour (Reichheld, 1996). One area that lacked scholar attention is outcome of satisfaction as consumers' corresponding behaviour towards a product or service (Yi, 1993). Consumers' behaviour in the current research is demonstrated by consumer level of acceptance, ownership and motivation to manage the water supply facility.

Satisfaction is positively related to purchase intentions (Yap et al., 2012) and satisfied consumers show less price sensitivity and are also willing to pay a higher price premium (Olsen, 2003). This revelation is vital as it gives insight on willingness of consumers to pay

for water supply service which is an indicator of ownership, acceptance and intention to manage a water facility.

The History of Satisfaction Research

Defining satisfaction has been a challenging task because it can be viewed from different levels of abstraction (single event versus collective impression on level of satisfaction received) and from different perspectives (individual firm or society) (Taylor et al., 2004).

Froehling, (2008) in his review of literature discussed the different perspectives in defining satisfaction, especially with respect to it, being a process or outcome (state) and whether the response is affective, cognitive and conative. Froehling (2008) noted that the debate helped define the domain of the elements. Satisfaction relates to an object (e.g. product or service), covers a time component (e.g. post purchase or post consumption) and involves a response (e.g. cognitive and/or affective).

The outcome or state oriented consumer satisfaction perspective assert that consumer satisfaction is a static concept, which is a cognitive and an effective response obtained through a current transaction or current consumption experience.

The process oriented consumer satisfaction examines whether the whole process of consumption experience achieves an expected result or not. This view is in line with the purpose and nature of the current research considering that unlike shelved products water supply products like boreholes go through a process of development and the process of consumption begins at inception of the project.

The current research also adopts the view that overall satisfaction is a global evaluation resulting from the service experience in agreement with Olsen et al., (2003) and Oliver's (1999) conceptualization of satisfaction as a post usage evaluation of state or feelings towards a product or service.

Satisfaction Models and Approaches

The disconfirmation of expectation model is much employed in marketing research. The model assumes that individuals evaluate product performances by comparing the perceived performance with their expectations (Smith & Bolton, 2002; Taylor et al., 2004). When perceived performance exceeds expectations it causes positive disconfirmation or satisfaction for positive behaviour display, and when perceived performance is below expectations, it causes negative disconfirmation or dissatisfaction (Zeithaml et al., 1996). Although this model has thus far been supported by numerous empirical studies (e.g., Mittal

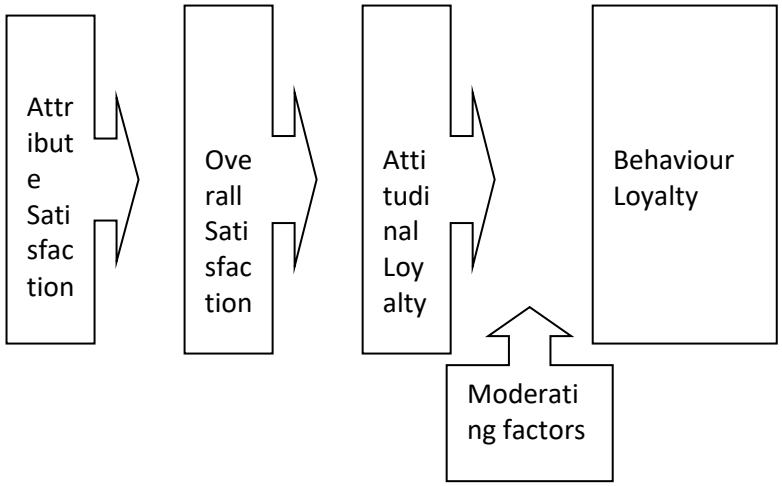
& Kamakura (2001), Kumar (2002); Oliver 1993), it has yet to incorporate further complexities that may arise in the process of arriving at global satisfaction.

The current research is guided by Montgomery et al. (2009) study on functional sustainability of rural water supply that all efforts towards functional sustainability of rural water supplies should try to reveal and manage the challenges being faced by water supply system in a particular setting. Froehling (2008) study on effect of satisfaction on attitudinal and behavioural loyalty of customers also assists the researcher in focusing on consumer satisfaction with the service as the central part of the sustainability formula. Customer loyalty is one of the key long term effects of satisfaction (Myers, 2003). Research on brand loyalty dates back to 1920 (Copeland, 1923); during these early days experimental research attempted to explain why consumers chose certain brands over an extended period of time.

Borrowing from what Rust & Zahorik (1993) say about the relationship between customer satisfaction and profits. The relationship between end user satisfaction and functional sustainability of rural water facilities may be a very complex one and should indeed include many intermediate links. The current research attempts to resolve this complexity by first understanding the root causes of consumer satisfaction and evaluating how the root causes can be managed; the current research further attempts to understand how each factor impacts on sustainability so that the nature of impact is established if it is causal, supportive or influential. In order to better model the impact of end user satisfaction on sustainability, one has first to examine and comprehend how end user's satisfaction is triggered and how it influences end user behaviours' responses (Zeithaml, 1990). In the current research profits are synonymous to economic and healthy benefits of a sustained water supply facility.

According to Montgomery et al. (2008) sustainability in rural water supply has been seen as a three faceted constructs that has effective community demand, local financing and cost recovery and dynamic operations and maintenance dimensions. By working on the root causes of the challenges facing the rural water supply then the researcher will show the causal relationship between various factors that triggers consumer behaviour. The satisfaction–loyalty model by Froehling (2008) can be presented as below and it shows the interplay between key independent and depended variables of satisfaction and this model could be very useful in the current research:

Figure 5: Satisfaction-Loyalty Framework




Source: Froehling (2008)

Figure 5 presents a satisfaction loyalty framework and how that relationship can result in behaviour of the consumer. Based on a process-oriented model, consumer (dis)satisfaction toward different foci of product usage/consumption can be considered as an antecedent to global (dis)satisfaction. These multiple reactions, as noted by Smith & Bolton (2002), tend to be independent from each other. For example, consumer may be satisfied with one aspect of the product while dissatisfied with another aspect (Attribute satisfaction). The varying satisfaction levels of consumers on different components of the product may vary in the degree of satisfaction or dissatisfaction, resulting in conflicting feelings of the overall product called overall satisfaction (Anderson et al., 1994). In addition, Taylor et al., (2004) stress that these different components tend to vary in terms of their ability to impact (dis)satisfaction: (1) some increase satisfaction when present but do not increase dissatisfaction when absent, (2) some increase dissatisfaction when absent but do not increase satisfaction when present, (3) some impact both satisfaction and dissatisfaction and negative evaluations to the extent that they are present or absent, and (4) some have no impact on satisfaction and dissatisfaction.

According to the researcher root cause analysis could be a solution in solving the challenges faced in water supply and has the potential to innovatively solve rural water supply sustainability challenges. Rural water supply literature mentioned many times of importance of consumer satisfaction with the water supply service in stimulating positive consumer behaviour towards rural water supply sustainability but no comprehensive research has

been done so far in that respect to uncover reasons behinds failing consumer satisfaction. This aspect of satisfaction as a potential stimulus for positive consumer behaviour for rural water supply sustainability leads the researcher to two other research questions:

RQ3: What could be the determinants of consumer (dis)satisfaction in rural water supply?

RQ4: How does consumer satisfaction affect consumer behaviour in rural water supply?

## 2.6 Developing a Satisfaction Based Framework for Rural Water Supply Sustainability

Literature review shows that an analysis of what determines functional sustainability of rural water supply facilities is much related to the behaviour of the consumer. Critical aspect of a sustainable water facility is dependent on consumer willingness and ability to manage it (Choguill, 1996). Montgomery et al., (2009) support this by indicating that dynamic operation and maintenance is critical and has largely been overlooked by funders, operators and managers of water supplies resulting in high levels of non-functional water systems. Sutton (2009) says that many reasons for low levels of sustainability of rural water systems in sub Saharan Africa are caused by poor operation and maintenance by user communities (owners). This finding from literature creates yet another area of further research that is; understanding what influences consumer behaviour towards management of a water supply which is directly linked to the problem statement of the current research. The current research unearths this by conducting empirical research to establish triggers of positive consumer behaviour in rural water supply through a root cause investigation approach in chapter four of the current research.

Antecedents to behaviour can be influenced and moderated by varying factors; however the theory of reasoned action and the theory of planned behaviour that dates back as far as 1980s (Froehling, 2008) hypothetically help to conceptualise how certain behaviours come to being. The theory affirm that behaviour is a function of behaviour intention and that positive intention should result in positive action. The theory of reasoned action also say that behaviour is a result of thinking or intentions that are triggered by a stimulus (Froehling, 2008).

Literature is in agreement that acceptance and ownership of the water facility is important and that it influences operation and maintenance of rural water facility. This presupposition has a notion in consumer research that individuals have “a sense of self,” being reflexively

aware of and able to perceive, assess, and define themselves or their identities in relation or contrast to surrounding objects (see Oliver, 1999). Moreover, as Neal et al., (1999) has suggested, congruency assessments are not restricted to tangibles but also apply to intangibles such as services, persons, and abstract ideas, as well as to organizations.

Developing rural water supply sustainability frameworks or models that do not give insight on antecedents to consumer behaviour is insufficient in addressing sustainability problems of rural water supplies. The current rural water sustainability models or approaches in literature depict this gap of addressing the "how" question of sustainability and that is the main research goal of the current research;

*"Development of a practice framework for stimulating desired consumer behaviour for functional sustainability of rural water supplies"*

In consumer marketing literature, satisfaction is critical in determining relationship between the consumer and the product (Olsen & Johnson, 2003). Since the focus of the current research is on behaviour at the interface between the consumer and product, then satisfaction becomes a core element to the current research as an antecedent to behaviour intentions and actual behaviour itself. The nonexistence or missing of a practical framework for solving rural water sustainability problems takes the researcher to the fifth research question of the current research as follows:

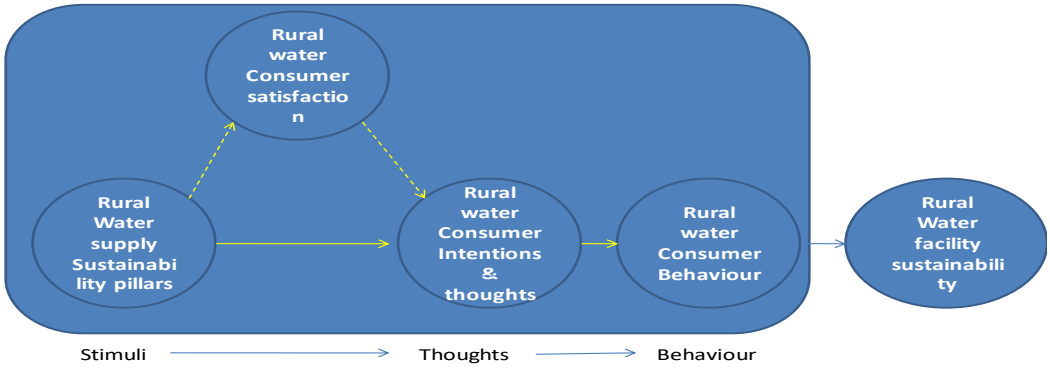
RQ5: What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?

## 2.7 Synopsis of Theoretical Background

This section provides a brief summary of the theoretical background upon which the current research argument is based (see figure 6 below). The circle on the far left represents the five identified sustainability pillars. The solid arrow on the right shows positive effect that the sustainability pillars have on consumers' intentions and eventually the positive impact on consumers' behaviour for sustainability of rural water supplies; this is in line with the cognitive behaviour theory or model (Oliver, 1993), the cognitive-behaviour model has three assumptions. The first assumption is that cognitive processes and content are accessible and can be known; the second assumption is that our thinking mediates the way that we respond to environmental cues; the third assumption is that cognitions can be intentionally targeted, modified and changed. The cognitive-behaviour model assists in understanding that by working on managing some underlying factors then it is possible to intentionally target some desired cognitions and thereby influence some behaviour. Given all the above

linkages, the current research explores the determinants of rural water consumer satisfaction and the current research asks whether effects on consumer satisfaction have in turn any effects on rural water consumers' intentions and thoughts to display desired rural water consumer behaviour for sustainability of rural water supplies. The process in the rectangular box represents the cognitive behavioural model.

Figure 6: Current Research Theoretical Background




Source: The Author

According to figure 6 above, the cognitive-behaviour model can help in devising a robust framework for managing rural water sustainability. The idea is to use this model in understanding the process of stimulating how consumer decisions can be triggered for sustainability of rural water supply. The cognitive–behaviour model presented in figure 6 above helps in understanding the decision making process and how that process can be influenced. Satisfaction will be enhanced by improved service on frequency of breakdowns and length of down time periods. When satisfaction as a stimulant is enhanced it should trigger positive intentions and thoughts that should result in positive consumer behaviour otherwise a state of imbalance will be attained (Oliver, 1999).

## 2.8 Research Questions

A review of rural water supply literature seems not to provide an overarching solution for functional sustainability of rural water facilities. The consumer is still not the main focus despite the fact that consumers are expected to manage the water facility in the rural areas. Meaning issues that influence their behaviour are yet to be assessed and incorporated in the formula for sustainability. Literature also is very sketchy failing to show linkages and interactions of proposed actions to the failing sustainability pillars and consumer behaviour. Hence, the main research goal (Ref: literature review section 2.7):

*"Development of a practice framework for stimulating desired consumer behaviour for functional sustainability of rural water supplies"*

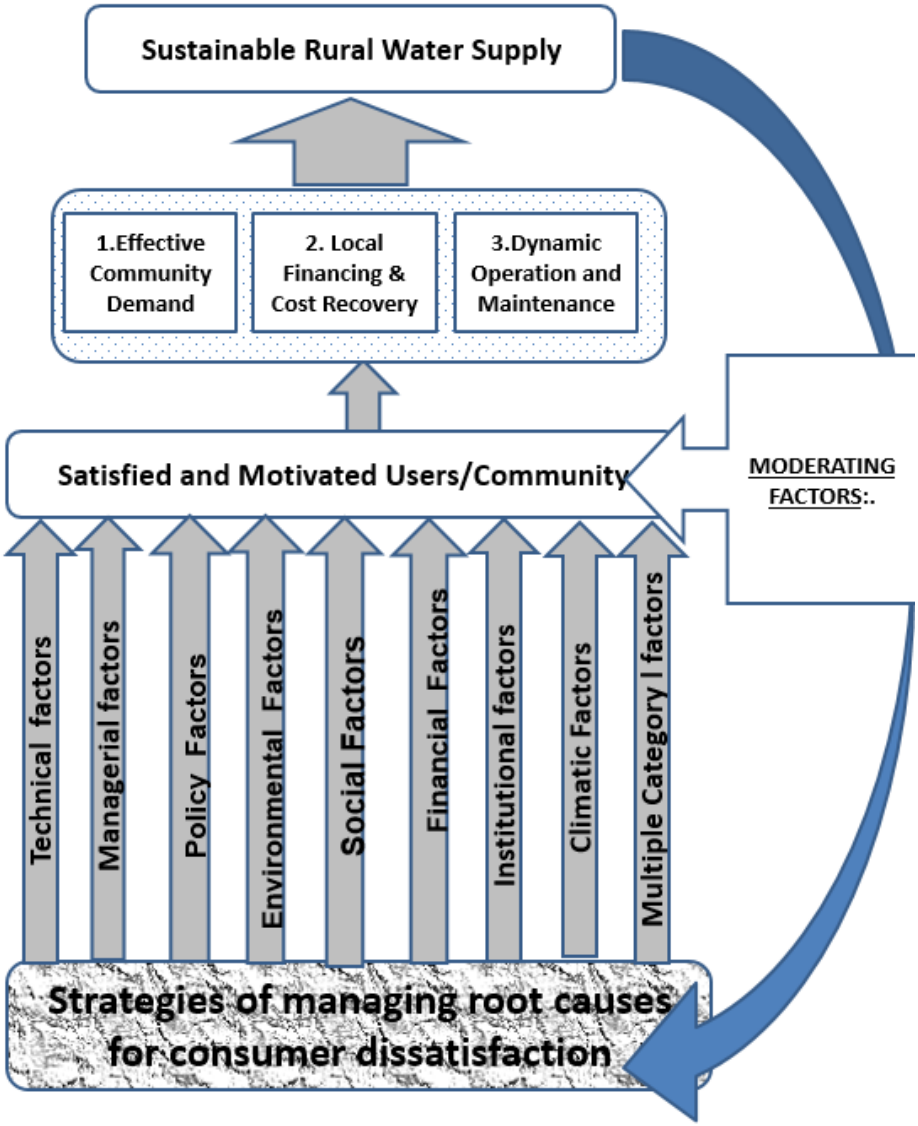
This goal aims at filling the literature gap; which can be addressed by unearthing the underlying issues of failing sustainability of boreholes and developing a consumer satisfaction based rural water supply framework that would drive focus of rural water supply service providers towards consumer satisfaction.

In summary the following research questions have been developed based on gaps in literature to explore fundamentals of consumer behaviour in management of rural water supply and assist in developing the proposed satisfaction based rural water supply sustainability framework.

1) What could be the role of the consumer in rural water supply facility sustainability?
2) What could be the pillars of a sustainable rural water supply
3) What could be the determinants of consumer (dis)satisfaction in rural water supply?
4) How does consumer satisfaction affect consumer behaviour in rural water supply?
5) What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?

The research questions above shaped the current research conceptual framework depicted in figure 7. The conceptual framework is developed from findings of literature discussed in this literature review chapter. It has been found in literature review that sustainability of rural water supplies has been viewed from the perspective of understanding the factors that affect sustainability. These factors were further classified into categories as presented in figure 7 below. It has also been established from literature review that motivated consumers or community displays effective community demand for water services, locally finance for capital cost recovery and engage in dynamic operation and maintenance essential for sustainability of rural water supplies. These three components of rural water supply were found to be fundamental for rural water sustainability. The conceptual framework in figure 7 has gaps in understanding the problem root causes of failing sustainability neither does it develop the strategies of managing those problem root causes. The conceptual framework also fails in establishing the severity of quality of service that would result in a majority of the community motivated or satisfied. The current research is envisaged to fill these literature gaps by responding to the research questions and research objectives. The conceptual framework in figure 7 below will be enhanced by findings in the current research and the reviewed final form of rural water sustainability will be presented in the discussion and conclusion chapter of the current thesis.

Figure 7: Conceptual Framework of a Sustainable Rural Water Supply System




Source: Author

The very bottom block in figure 7 above is for strategies for managing the root causes for consumer dissatisfaction or failing rural water sustainability. This is one of the major gaps in literature for rural water sustainability. The bottom arrows represent the categories depicted in literature as essential for sustainability, these are categories of the many factors found in literature to be affecting sustainability. If these categories of factors are adequately and effectively managed then a motivated and satisfied community will be achieved the gap found in literature is understanding the severity level of service that would result in demotivation or dissatisfaction of the community.

Effectiveness of the classified categories is dependent on effectiveness of various strategies and solutions in managing the root challenges that affect the various categories. The next upper block depicts overall satisfaction that consumer experiences from various actions that service provider undertake as they are rolling out the water project. The next upper single arrow depicts the behaviours displayed by the consumer as an effect of overall satisfaction experienced from execution of various strategies; the expected behaviours can either be all or some of the three behaviours that result to a sustainable rural water supply as presented by Montgomery et al., (2009). The curved arrow that comes from the top to the consumer represents the sustainability circle of rural water supplies where sustainability becomes a source of satisfaction that affects further display of positive behaviour for sustainability of rural water supplies throughout the design life of the water source infrastructure.

## 2.9 Dimensions of a Sustainable Rural Water Supply System

Literature review shows that there are eight specific categories of factors namely Technical, Managerial, Policy, Environmental, Social, Financial, Institutional and Climatic categories that need to be assured in order to attain sustainability. The ninth category is on factors that belong to multiple categories (Ungwe, 2015). The categories are explained and presented in table 4 below. The researcher however believes these categories are too ambiguous to develop a practical framework or model. Understanding categories or dimensions is good but does not solve sustainability problems of rural water supply rather specific structural pillars that support rural water supply sustainability need to be found in addition factors that result to failing of these pillars need to be identified so that they are managed. The researcher will therefore identify these structural pillars from the current research as presented in chapter four of research findings.

Ungwe (2015) in the research on sustainability of drinking water supplies summarized factors that affect drinking water services in Malawi as in table 4 below. Much as Ungwe (2015) research work was on drinking water services but it was very specific to piped drinking water services managed by department of water services. The current research is now specific to rural water supply borehole systems which are predominantly the main source of safe water in rural areas. The current research is focusing on boreholes fitted with hand pumps and managed by consumers/communities. The current research is paramount and justifiable because it is dealing with the primary and predominant means of supplying safe water to rural communities in Malawi (Malawi Government, 2014) and hence building on Ungwe (2015) findings from rural water supply piped water systems.

Table 4: Categories of Factors that Affect or Can Easily Affect Sustainability of Water Supply Services in Malawi

| Sustainability Categories with Factors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Technical | Managerial | Policy | Environmental | Social | Financial | Institutional | Climatic | Miscellaneous |
| 1.Type of technology<br>2. Quality of infrastructure<br>3. Proper handover of new infrastructure<br>4. Infrastructure that works as required<br>5. Continuous upgrading of infrastructure e.g. extension of pipe network<br>6. Preventative maintenance<br>7. Rate of breakdown of Infrastructure<br>8. Extent of breakdown of infrastructure<br>9. Performance of consultants<br>10. Performance of contractors | 1. Rewards to people involved in provision of DWS services<br>2. Involvement of trained personnel 3. Continued training<br>4. Involvement of motivated personnel 5. Organisational culture adaptation to a project<br>6. Human resource management<br>7. Realistic objective | 1. Supportive legislation/ policies<br>2. Stability of economic status of users<br>3. Population growth rate<br>4. Developmental improvements<br>5. Equity in distribution of water resource | 1. Natural condition of water catchment area<br>2. Protection of water source/catchment area<br>3. Quantity of raw water<br>4. Quality of raw water<br>5. Perennial source of water<br>6. Social/economic activities in water catchment are | 1. Involvement of appropriate stakeholders<br>2. User involvement<br>3. Demand responsive approach<br>4. User satisfaction with a service<br>5. Achievement of benefits by users e.g. health and economic<br>6. Continued use of supplied water as expected at | 1. Availability use of adequate financial resources | 1. Management arrangement (type) for water supply system<br>2. Spare parts supply<br>3. Maintenance tools supply | 1. Climate change impacts | 1. Lessons from past projects/ organisational learning<br>2. Troubleshooting<br>3. Safety of workers<br>4. Involvement of senior managers in a project<br>5. External support<br>6. Project owner requirements<br>7. Project sponsor regulations<br>8. Supervision of subordinates<br>9. Level of water loss<br>10. Wasteful usage of water<br>11. Water demand management<br>12. Inter-community competitions<br>13. Political support/interference |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11. Capacity to maintain infrastructure<br>12. Capacity to operate infrastructure<br>13. Performance of suppliers<br>14. Availability of alternative water sources<br>15. Efficiency of using water resources<br>16. Vandalism of infrastructure<br>17. Growth of water demand<br>18. Age of infrastructure<br>19. Availability/adequacy of supplies e.g. power supply<br>20. Leaking water supply facilities | | | | the design stage | | | | 14. Realisation of service provider expectations |
| | | | | | | | | |

Source: Ungwe (2015)

Table 4 has classified the sixty factors that affect rural water supply into eight categories. It is important to understand categories of factors affecting rural water supply because it helps in systematic programming of rural rural water supply interventions and allocation of resources. By classifying factors that affect sustainability it is possible to determine and account for resources spent on each category thereby understanding efficiency of each category.

The Malawi Ministry of Irrigation and Water Development recommends 1) financial self-sufficiency and 2) decentralised day-to-day management of drinking water supplies as means for drinking water services to be sustainable in Malawi (World Bank, 2007). Analysing the recommendations from the Malawi Ministry of Water, it is clear that the root causes of borehole rural water supply sustainability failure are not solved.

The following are the challenges of borehole rural water supply systems as presented in the problem statement of chapter one:

a) Frequency of breakdowns of the borehole in a unit period of time (Functionality)
b) Time taken to fix a breakdown (downtime periods)
c) Capacity of the borehole to produce adequate water
d) Capacity of the borehole to produce safe water

Understanding the existing frameworks in rural water supply including the categories of factors mentioned for sustainability of drinking water services (See table 4), it is clear that sustainability of rural water supply will continue being a mystery and complex issue to tackle. Categorisation of factors do not play a role in management of the factors essential for sustainability rather it helps in classification of the factors (Ungwe, 2015) signifying the need to identify the underlying factors if sustainability is to be attained.

Rebori (1997) and Restructuring Associates Incorporation (2008) suggest identification of root causes as the best approach in problem solving agreeing with assertion from Dew (1991) and Doggett (2005) that the challenge of not managing the root causes is that unsustainability of drinking water services will continue. Considering the challenges faced by borehole rural water supply services it is imperative that the root causes be unearthed, analysed and managed.

## 2.10 The Consumer Satisfaction Based Rural Water Supply Framework

Failure of the existing frameworks to sustain community borehole rural water supply systems is in three folds:

1) First is the failure to recognize the fact that with borehole rural water supply systems (BRWSS) it is the consumer who is the driver for sustainability unlike other rural water supply systems where an entity like Water User Operator is at the driving seat. In the current research the consumer is the centre of sustainability and all strategies employed are targeted at managing the challenges faced by consumers in rural water supply thereby increasing their satisfaction and consequently increasing consumer's likelihood to positively behave for sustainability of their BRWSS.
2) Second is the failure to recognize the limitations of the factors. Working on the factors does not necessarily mean managing the root causes that affect the factor such that unmanaged root causes continue to undermine all efforts of ensuring that a specific factor is done resulting in recurrent sustainability failure of the BRWSS. The current research will understand the limitations (root causes) faced by the factors and manage them as they are key for sustainability of rural water supply.
3) Third is the failure to recognize context as a paramount element of practicality of the frameworks. In the current research the new framework is supposed to be practical for the Malawi context as such empirical solutions need to be evaluated and used in the framework.

## 2.11 Research Proposition

It has been noted in the problem statement that many consumers are dissatisfied with the BRWSS because many boreholes water supply systems fail to continuously supply safe water in adequate quantities for the design life time. This statement is as a result of a number of challenges like:

a) Frequent breakdowns of the borehole in a unit period of time (Functionality)
b) Lengthy periods/time taken to fix a breakdown (downtime periods)
c) Lack of capacity of the borehole to produce adequate water
d) Lack of capacity of the borehole to produce safe water

When consumers are dissatisfied with the water facility the result is consumer unwillingness to continue sustaining the BRWSS. In other words there is an imbalance between what the consumer perceived of the service and what the consumer is actually experiencing leading to consumer dissatisfaction.

To ensure that BRWSS are sustainably cared for then it is imperative that the challenges faced are solved from their roots. When all the root causes are managed then consumer satisfaction is going to be attained. Consumers will be triggered to behave in a manner

essential for sustainability of the BRWSS. Based on this assumption then a proposition is made that:

*BRWSS in Malawi can be sustained if all the root causes responsible for consumer dissatisfaction can be identified and managed*.

## 2.12 Research Questions

Considering the research objectives of the current research then it is important that some specific questions are answered to address the research problem.

1) What could be the role of the consumer in borehole rural water supply sustainability?
2) What could be the pillars of a sustainable borehole rural water supply?
3) What could be the determinants of consumer dissatisfaction in borehole rural water supply?
4) How does consumer satisfaction affect consumer behaviour in rural water supply?
5) What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?

## 2.13 Conclusion

This chapter provided a mass of research findings on management, operation and maintenance of rural water facilities. Working definitions of “sustainability” were derived from literature. Through a review of literature this chapter has identified eight categories of factors essential for sustainability of rural water supply. This chapter has unearthed literature on “satisfaction” and how satisfaction influence behaviour. Low functional sustainability of rural water facilities has also exposed the need to have a sustainability framework in this case derived from root causes of sustainability failure. Five research questions were formulated to address the research problem and aims of the current research.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.0 Introduction and Overview

Chapter two provided a review of literature relevant to the current research. This chapter introduces the reader to the chosen mixed methods approach. It gives the rationale behind this choice in relation to the philosophical assumptions of pragmatism, the research context and aims, and continues with the presentation of the important aspects of the research design, namely mixed methods of data collection, analyses and sampling.

The current research uses a cross sectional survey, interviews and focus group discussion method to identify determinants/root causes of consumer satisfaction and dissatisfaction in rural water supply and establish their impact on sustainability of rural water supply. The purpose of the design is to identify patterns, relationships, prediction and linkages of sustainability factors, pillars, consumer satisfaction or dissatisfaction and rural water supply sustainability. The current research adopted a mixed methods approach and collects data through a survey strategy using structured interviews and qualitatively through focus group discussions and interviews using semi-structured interviews. The two research methodologies adopted are specific to the nature of the research questions.

The current methodology chapter begin by presenting the research goal and research questions, this part is important as the methodology depends on the goal of the current research and the research questions at hand. The chapter start by locating the epistemological standpoint of the study which presents the position picked by the researcher from the range of paradigms available. This stage is significant as it enabled the researcher understand the type of data to be collected and the kind of questions to be asked. The next section of this chapter is on methodology itself; having known the position of the researcher and the type of data to be collected various tools were analysed in order to understand which method is the best and which one fits the current research. The latter section tackles the research design which is basically a systematic approach that assist in finding solutions to the research questions; it includes description of the sample, research tools, and data collection process and procedure and data analysis. This chapter concludes with a summary.

## 3.1 Research: Goal and Questions

As per Denzin & Lincoln, 2005, Silverman, 2005, and Yin 2002, the choice of the research methodology depends on the problem to be solved and the research question to be answered.

The research problem for the current research is:

*"The rural water supply consumer willingness to support sustainability of the rural water supply decreases with increase in consumer dissatisfaction.*

A review of existing sustainability rural water supply frameworks or theories has failed to comprehensively provide solution for increasing consumer satisfaction (Sara and Katz, 1998). Analysis of these frameworks and concepts in literature review show that satisfaction is only thinly tackled and assumed to be achieved through community participation and involvement in other words root causes are not tackled and managed. It also shows that little effort has been put in research to establish determinants of consumer dissatisfaction and satisfaction in rural water supply; consumer satisfaction is an indicator of likelihood to continue paying tariffs and care for the water facility (Sara and Katz, 1998) hence the research goal.

The overall goal of the current research is to develop a practice framework for stimulating desired consumer behaviours for functional sustainability of rural water supplies by means of identification and management of root causes of consumer dissatisfaction with rural water supply. This is a framework that is envisaged to enhance consumer satisfaction in rural water supply and it starts by establishing determining pillars essential for consumer satisfaction in rural water supply systems in other words the framework should adopt a people centred approach where by consumers are the focus.

The missing link in the existing concepts and theories is clearly on how to trigger positive behaviour for sustainability of rural water supplies. The proposed framework in the current research brings forth that perspective and solves the problem. The following research questions are therefore developed to address the gaps in literature:

1) What could be the role of the consumer in rural water supply facility sustainability?
2) What could be the pillars of a sustainable rural water supply
3) What could be the determinants of consumer (dis)satisfaction in rural water supply?
4) How does consumer satisfaction affect consumer behaviour in rural water supply?
5) What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?

These research questions attempt to address the rural water supply sustainability problem by dealing with the identified research and literature challenges on rural water supply consumer satisfaction. This stage directs the current research into a thorough process of

selecting an appropriate paradigm that will guide the research process in finding correct responses to the research questions.

## 3.2 Philosophical Assumptions

Decisions regarding focus of research, the phenomena it may investigate and the means through which investigations takes place are all preceded by consideration to the theoretical framework and paradigms to which a researcher prescribe. Although a chosen methodology is guided by the nature of the research objectives and questions (Robson, 2002), it is not simply an issue of a study's aims, but it is also influenced by particular philosophical assumptions (Baert, 2005, p. 154). Such assumptions concern the way the researcher perceives the nature of reality (ontology) and knowledge (epistemology), and are related to particular methodological approaches (Maxwell, 1988).

Research philosophy spans between epistemology, ontology and axiology. In fact according to Johnson et al., (2004) the word epistemology is in two parts: episteme "science or knowledge" and logos "knowledge, information theory or accounts". Epistemology is "what can be accepted as knowledge in a certain field or discipline" (Baker and Foy, 1993). Ontology is concerned with nature of reality, which means the assumptions researchers have about how the world operated (Saunders et al., 2007). On the other hand axiology is simply what values go into research (Creswell, 2011).This set of beliefs form what is called "paradigm" and influence the whole research process (Lincoln and Guba, 1985).

Paradigm is central and needed for any research regardless of its field or aim (Creswell, 2011), in fact the idea of paradigm was brought about by Thomas Khun in the early 1960 and it means how people govern their thinking and actions through standards, judgments, norms, value judgments...etc. According to Creswell (2002) the paradigm adhered to has implications for the way in which the researcher construes and interprets information and data. Adhering to a given paradigm subsequently guides the researcher's decisions regarding methodological procedure and design.

Different paradigms are linked to different philosophical assumptions and, consequently, to different methodological approaches. According to positivism, for instance, reality exists "out there" as an objective entity, and it is knowable in its entirety (Fontana & Frey, 2003). Advocates of positivism use quantitative methods, involving deductive research strategies, such as experiments and surveys in order to test hypotheses based on particular theories (Crotty, 1998; Patton, 2002). In contrast, according to interpretivist, reality does not exist as an objective entity separate from human subjectivity, but it is comprised of multiple constructed realities, resulting from people's experiences and the meanings they attach to

it (Lincoln and Guba, 1985; Della Porta and Keating, 2008). Interpretivists believe that knowledge is created through the interaction between human beings and their world (Lincoln and Guba, 1985; Crotty, 1998). They seek different ways to understand processes and experiences, and their preferred methods are qualitative, with strategies including induction, exploration, and theory generation (Johnson and Onwuegbuzie, 2004; Denzin and Lincoln, 2005). Such competing standpoints about the nature of reality and knowledge have caused a long standing debate within the social sciences, with important methodological implications (Streiner et al., 2008).

In order to implement a research framework a researcher should first develop the knowledge claims which are the assumptions of the research. Then the researcher selects the most suitable method to perform the research and test the developed assumptions. Actually according to Smith (1995) the decision to use quantitative or qualitative method is driven by assumption concerning knowledge and reality, and the process of acquiring knowledge and knowledge about reality.

Central to this debate are considerations of the superiority of positivism and quantitative methods from one hand, and the superiority of interpretivist and qualitative inquiry on the other hand (Patton, 2002; Johnson and Onwuegbuzie, 2004). Within the social sciences in general, and within management studies in particular, there has been an emphasis on the positivist tradition, often due to an attempt to achieve “scientific” legitimisation (Bailey and Ford, 1996; Bennis and O’Toole, 2005; Starkey and Tiratsoo, 2007). The same emphasis on positivist research modes and for the same reasons has been also given in tourism studies (Tribe, 1997; Walle, 1997; Botterill, 2001; Goodson and Phillimore, 2004; Cooper et al., 2005). Similarly, psychological research has been highly quantitative since its conception, however, with a growing interest in qualitative research since the 1960s (Gelo et al., 2008). Such a shift towards the acceptance of qualitative research has been evident in the wider social sciences, since the 1980s (Huberman and Miles, 2002; Denzin and Lincoln, 2003), with some disciplines (e.g. management studies) adopting faster (Catterall, 1998; Milliken, 2001), and some others (e.g. tourism) somewhat slower (Phillimore and Goodson, 2004).

It is very useful that appropriate paradigms are chosen to address a particular set of research questions, the process in scientific research is important as it guides the type of data to be collected, the questions to be asked, how the questions can be asked as well as how the results should be interpreted (Kuhn,1962). Though research paradigms are classified into several categories like positivism, post-positivism, critical theory and Interpretivism as was done by Guba and Lincoln (1985) the main categories of research

paradigm are as were done by Fitzgerald and Howcoft (1998). These researchers classified research paradigms as positivist and Interpretivist research paradigms whilst in between or a combination of both is a pragmatists research paradigm.

Notwithstanding the level of acceptance of these two research paradigms and their respective methodologies among different disciplines, their advocates had been long "concerned with defending their accustomed lines of inquiry, than with indicating the possible points of convergence with other approaches" (Fielding and Fielding, 1986, p. 10). In contrast to this rather narrow approach to inquiry there are arguments about the necessity of more open and dialectical approaches. Feyerabend (2010[1975], p. 4), for instance, points out that, "the world we want to explore is largely an unknown entity. We must, therefore, keep our options open and we must not restrict ourselves in advance." Similarly, Freire (1972a, p. 27) argues, that objectivity cannot be conceived without subjectivity and vice versa, and that both are in a constant dialectical relationship.

Inquiry as an evolving process has responded to such arguments and has seen the variety of its approaches expanded beyond the two dichotomised stances (Patton, 2002). This expansion has been the result of the emergence of alternative worldviews to those of positivism and interpretivist. One such worldview is pragmatism, according to which, reality is both singular and multiple (Creswell and Plano Clark, 2011). Pragmatism rejects "pretended absolutes and origins" and favours "the possibilities of nature, as against dogma, artificiality, and the pretence of finality in truth" (James, 1907, p. 51). It challenges the contrast between objectivity and subjectivity as this "creates issues of prejudices about what constitutes credible and valuable contributions to knowledge, which limit methodological choices, flexibility and creativity" (Patton, 2002, p. 71). Such ideas have led to the argument that "Pragmatism offers a third choice that embraces super-ordinate ideas gleaned through consideration of perspectives from both sides of the paradigms debate in interaction with the research question and real world circumstances" (Teddlie and Tashakkori, 2009, p. 73). As such, pragmatists focus on synthesis instead of dichotomisation, and combine deductive and inductive thinking in their inquiry (Johnson and Onwuegbuzie, 2004; Creswell and Plano Clark, 2011).

The current research reflects a pragmatic approach to social inquiry, driven by its goal and the nature of the research questions, rather than a preconceived preference associated to specific methodologies and research methods (see Johnson and Onwuegbuzie, 2004). This pragmatic approach has the advantage that "allows one to eschew methodological orthodoxy in favour of methodological appropriateness as the primary criterion of judging methodological quality, recognising that different methods are appropriate for different

situations" (Patton, 2002, p. 72). In addition, such an approach is consistent with the overall aim of the current research, which is to produce socially useful knowledge (see Feilzer, 2010). Despite these advantages, pragmatism, like any other philosophical approach, has its shortcomings (e.g. workability or usefulness can be vague unless explicitly addressed) (see Johnson and Onwuegbuzie, 2004, pp. 17-19).

### 3.2.1 Interpretive Research Paradigm

An interpretive epistemological position advocates for the necessity to understand differences between humans in their role as social actors (Saunders et al., 2009). It is guided by realism; they believe that reality and the observer can never be separated. Relativism believe that it is the observer who determines and constructs reality by their experiences, social background and other factors, in other ways the interpretivists are subjectivist.

According to Crewell (2002), Saunderes et al., (2007), Easterby-Smith et al., (2002) the interpretivist researcher is interactive with what has been researched and findings are probably true. They focus on generating theory and meaning from data based on accounts of participants (Creswell, 2008). Advocates of this paradigm suggest that reality is socially constructed (Mertens, 2005), often opting to use qualitative methods of data collection and analysis as a result.

Rural water sustainability revolves around consumers' behaviour. Behaviour studies require making sense of participants' feelings thus bringing in the interpretivist thinking into the current research.

### 3.2.2 Positivist Research Paradigm

The explanation from Myers (1993) is probably one of the simplest explanations of a positivist. Positivists are driven by objectivism and interpret reality as independent of peoples' perception or consciousness. Positivists separate the researcher and his or her instruments from reality and attempt to define the truth by measurable properties.

With positivism the reality is objective and it is seen as singular and separate from the researcher in other words "Reality is real". It is knowable "true nature" so what is known is unchangeable as it is known by natural laws (Crewell, 2002; Saunderes et al., 2007; Easterby-Smith et al., 2002). These researchers also claim that positivist findings are true and objective. Advocates of positivism priorities the testing of theories and hypothesis and positivist research is often therefore associated with quantitative data (Podsakoff et al., 2003). Though positivism successfully works with natural sciences it is also considerably being adopted in social sciences (Collins & Hussey, 2009). The researcher is looking at

collecting quantifiable observation and put them to statistical analysis and positivism seem to share parts of this.

The current research has used existing work and theories around rural water sustainability to develop a hypothetical conceptual map on rural water supplies sustainability as presented in literature review chapter section 2.6 of this current research. This is later tested by instruments used to measure satisfaction, this will help to develop a framework that would enhance sustainability of rural water supplies. The idea is to develop a framework that should further be tested as the water and sanitation sector strives to find best possible solutions to rural water supplies sustainability in sub Saharan Africa. There by sympathizing with the positivism stand for some elements of the current research.

### 3.2.3 Pragmatist Research Paradigm

Strict adherence to one paradigm may restrict the creativity and curiosity of researchers (Kuhn, 1962) thereby limiting the potential of research to explore the social phenomena via a range of alternative applicable methods. Of course allegiance to either a qualitative or quantitative paradigms will subsequently result in the dismal of other paradigms according to Kuhn (1962).

As per above position argued by the researcher on interpretivist and positivism in relation to the current research, it is clear that there is compatibility between the two paradigms thereby agreeing with Rothbart (1982).

The nature of the current research dictates a combination of approaches that have allegiance to both paradigms. This is all about pragmatism which is a philosophical stand relevant to a mixed methods approach to research (Tashakkori & Tegddlie, 2003). The current research combines the quantitative and qualitative approaches in a mixed method study design, therefore adhering to the pragmatism paradigm within which the research questions are perceived as being of primary importance (Creswell et al, 2003) and the research methods chosen are considered to be the most appropriate for providing insight into their respective research questions.

The later sections of this chapter strengthen the position taken by the researcher of combining research methods for a reason of enhancing and elaborating the findings.

## 3.3 Determination of Research Methodology

The art of choosing the research strategy is in the research questions. Yin (2003) explains that what is important with a research strategy is whether it will enable you to answer your particular research questions. As such a research strategy will be guided by research

questions, objectives, extent of existing knowledge, amount of time and other resources available. As a precursor to introducing the design of the current research; quantitative, qualitative and a combination of the two methods will be explained in greater detail.

### 3.3.1 Quantitative /Fixed Designs

Quantitative designs are positivist in orientation and usually involve the collection of quantitative data, giving priority to experimentally orientated investigations such as randomised control trials and quasi-experiments. Fixed designs are theory driven (Robson, 2002) and typically consider statistical aggregates, general tendencies and correlations. Statistically significant patterns then form the basis of the conclusions drawn.

### 3.3.2 Qualitative/Flexible Designs

In contrast to fixed approaches, flexible designs are constructivist or interpretivist in nature; they do not start from a specific hypothesis and they are less concerned with causal relationships or the rigorous comparison of variables. Instead qualitative designs start with a 'problem' that the researcher wishes to explore. Next, holistic data collection methods and inductive logic are used, with a view to developing 'theories' and shared understandings regarding social phenomena (Mertens, 1998)

### 3.3.3 Mixed-Methods Design

As already mentioned earlier, pragmatism as a research paradigm, supports the use of a mix of different methods (Feilzer, 2010). Mixed-methods research reflects multiple standpoints, and lies somewhere in the continuum between quantitative and qualitative research, recognising the utility, and often the necessity, of both methodologies (Morgan & Smircich, 1980; Johnson and Onwuegbuzie, 2004; Flick, 2006; Johnson et al., 2007; Crotty, 2009). More specifically, it enables researchers to deal with the complexity of social life by using quantitative methods to measure some aspects of the phenomenon under study and qualitative methods for others (Feilzer, 2009). In other words, by adopting different methodologies it aims to map and understand the social world as completely as possible (see Feyerabend (2010[1975]; Baert, 2005).

This reflects the idea of triangulation, "an attempt to secure an in-depth understanding of the phenomenon in question" (Denzin & Lincoln, 2003, p. 7). The aim for in-depth understanding is not achieved without additional cost, as different methods require different amounts of resources (e.g. research skills, money and time) which make mixed-methods research particularly challenging, especially for researchers working independently and on self-funded projects (Brannen, 1992; Frost, 2011; Creswell & Plano Clark, 2011). While, acknowledging these challenges a combination of methods approach was followed.

The current research's design consisted of separate quantitative and qualitative phases. The first phase data was collected through a survey, using research assistants to collected data. This phase of the current research addressed all research questions but more specifically research questions 2, 4 and 5.

With regard to the second phase, semi-structured interviews were conducted during focus groups discussion to:

1) Understand through participants' own explanations on what their role is in ensuring functionality of their water supplies.
2) Understand the determinants of the focus group discussion participants' satisfaction or dissatisfaction with rural water supplies.
3) Understand the impact of consumer satisfaction and dissatisfaction on sustainability of rural water supply?

The two different methods utilised are further and separately discussed later in this chapter. What must be mentioned at this point is that; with regard to the priority or status of the quantitative and qualitative approaches, both had been given an equal weight, a choice that is consistent with the logic of mixed methods research (Darlington & Scott, 2002; Johnson et al., 2004). Consistent with this is the fact that attention allocated to data collection and analysis were roughly equal (Brannen, 1992). This was also an answer to such critiques that maintain that mixed methods inquiry relegates to qualitative methods a secondary status (Greene, 2006). Moreover, and although the research questions facilitated the adopted methodology, the two phases of the current research can be also viewed as two separate but linked studies (Brannen, 1992).

This overlap in the treatment of data was deemed as necessary to shed more light and provide a more complete picture of the phenomena under study (see Brannen, 1992; Darlington & Scott, 2002; Frost, 2011), something that could not be achieved through a single methodological approach (Bryman, 1988; Creswell and Plano Clark, 2011). The combination of surveys with semi-structured interviews is a classic mixed methods approach (Teddlie and Tashakkori, 2009). The table 5 below clarifies reasons why a mixed methods approach is preferred in many situations including the context of the current research.

Table 5: Advantages of Mixed Methods Approach

| Reason | Explanation |
|---|---|
| Triangulation | Use of two or more independent sources of data or data collection methods to corroborate research findings within a study. |
| Facilitation | Use of one data collection method or research strategy to aid research using another data collection method or research strategy within a study (e.g. qualitative/quantitative providing hypotheses, aiding measurement, quantitative/qualitative participant or case selection) |
| Complementarity | Use of two or more research strategies in order that different aspects of an investigation can be dovetailed (e.g. qualitative plus quantitative questionnaire to fill in gaps quantitative plus qualitative questionnaire for issues, interview for meaning) |
| Generality | Use of independent source of data to contextualise main study or use quantitative analysis to provide sense of relative importance (e.g. qualitative plus quantitative to set case in broader context; qualitative × quantitative analysis is to provide sense of relative importance) |
| Aid interpretation | Use of qualitative data to help explain relationships between quantitative variables (e.g quantitative/qualitative) |
| Study different aspects | Quantitative to look at macro aspects and qualitative to look at micro aspects |
| Solving a puzzle | Use of an alternative data collection method when the initial method reveals unexplainable results or insufficient data |

*Source:* developed from Bryman (2006)

By combining different methods of approach the current research is able to achieve a number of things from Table 5 above. For instance the combination of these methods is assisting in achieving triangulation of results by allowing collaboration of research findings. The current research approach also assists in achieving complementarily since use of different strategies enables different aspects of an investigation to be dovetailed. The use of independent sources of data in the current research to contextualise the main study helps the current research to achieve generality. The adoption of a mixed method of approach is of great use as it aids in interpretation thereby helping explain relationships between some quantitative or qualitative variables.

## 3.4 Research Design

The aim of the following sections is to clearly outline the current research design as a whole, in order to enable the reader to draw conclusions about the efficacy of the intervention (Lane at al., 2004) and to enable the replication of the intervention and or the research design. Yin (1994) defines research design as the logical sequence that connects the empirical data to a study's initial questions and, ultimately to its conclusion. The research design hence

defines the path way to conclusion and connects the dots in the contribution to knowledge process.

In order to answer the research questions that were developed in the current research a research design was done as follows: Starting by crafting the goal to development of research questions from literature review on satisfaction and rural water sustainability. A conceptual framework is developed from literature then a research paradigm and research methodology for data collection is determined. This continues with data analysis and ends with conceptual framework review which translates to development of Consumer satisfaction focused rural water supply sustainability framework.

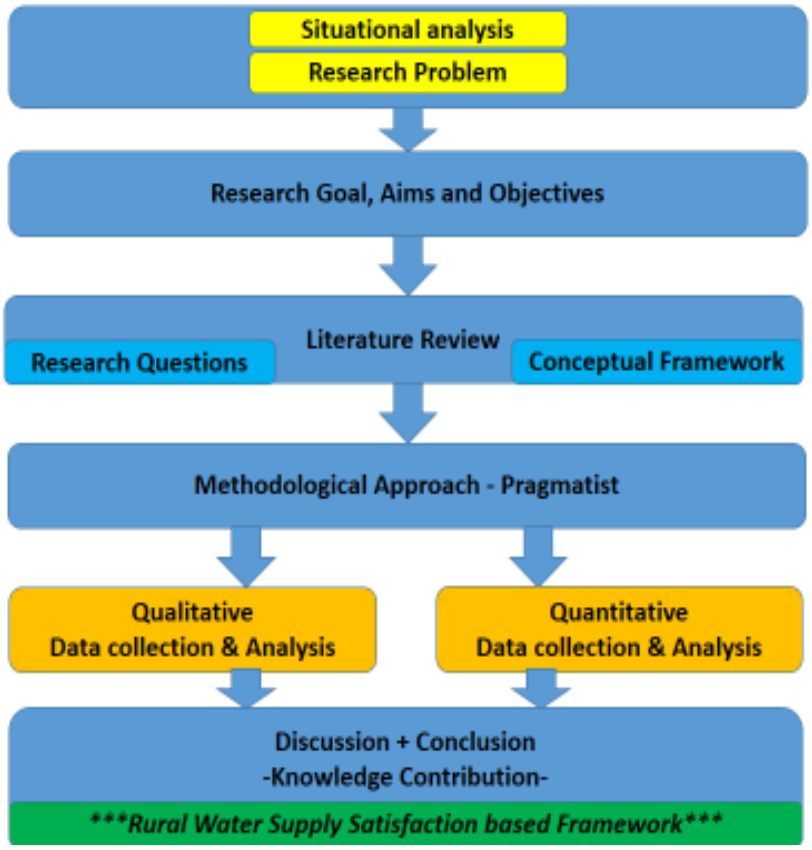
The current research utilises a combination of quantitative and qualitative research designs (Cresswell, 2003; 71). Within this current research design the following are evident:

- The study has two phases, the quantitative phase and the qualitative phase.
- The two phases are integrated at the data interpretation and discussion stage (Hanson et al, 2005; 229)

Advocates of a mixed methods research argue that clarity must be provided regarding the means for utilising a mixed methods design (Creswell, 2003; 61). The following reasons are provided for its use in the current research.

1. Completeness: The combination of the qualitative and quantitative approach are used to provide a more comprehensive account of the area of inquiry (Bryman, 2006);
2. Utility: It has been urged and it is applicable in the current research that combining approaches from quantitative and qualitative paradigms, the resultant data will provide a fuller picture of the phenomena of interest and be of greater use to practitioners in the field (Bryaman, 2006; Gulliford, 2015).

Figure 8: Research Design Process for the Current Research




Source: Author

Figure 8 above presents the research design process of the current research. It begins with synthesis of the situation and identification of the research problem from which research goal, aims and objectives are identified. Choice of relevant literature is a result of research objectives and it is the gaps noted in literature review that emerge into research questions and development. Similarly a conceptual framework is developed from literature review. The researcher is guided by what is appropriate in answering the research questions as such pragmatism is a preferred philosophical approach. Both qualitative and quantitative approaches and their appropriate data collection methods and analysis are adopted leading to discussion of results and determining knowledge contributions. The current research ends by development of a practice framework for provision of sustainable rural water supply.

The research problem and questions have already been dealt with in the literature review, a rigorous literature review was necessary to conceptualise the consumer focused rural water supply framework.

## 3.5 Research Methods

A number of research methods were considered for the two phases of the current research. Below is a description of various methods and the reason for adoption of a particular method. It is necessary to discuss the approaches in order to justify the chosen method.

### 3.5.1 Action Research

In an action research the researcher studies the problem, designs a model for overcoming a problem, rolls the solution into action and monitors the solution. The cycle of planning, acting, observing and reflecting enables the research to come up with a solid solution to the problem. Action research is therefore rich of literature on the subject matter; this is contrary to this current study where consumer satisfaction is a relatively new subject area in rural water supply justifying impracticality of the methodology in the current study.

Action research is situational meaning the solution may not yield similar results in another context, generalization of results is therefore a problem. Low sustainability of rural water systems is a broader problem and it affects many communities as such action research is not appropriate for the current research because findings cannot be properly generalized.

Most of all action research requires a considerable amount of time and the time constraint nature of the current research does not fit demands of an action research as a methodology. In action research, the researcher works in close collaboration with a group of people to improve a situation in a particular setting; the current research did not provide that luxury as the researcher may not have time to act as a facilitator. Action research is therefore not appropriate for the current research.

### 3.5.2 Ethnography

Ethnography is best approach suited in situations where one seeks to understand perspectives of the culture of individuals, groups or systems occurring in settings or fields (Gray, 2004). To better understand culture more time is required in gathering data, it involves recording activities over time and interpreting it.

Ethnography studies focus on culture and phenomenology. The current research is not trying to understand culture rather it is intending to study aspects that make the consumer satisfied. Ethnography is therefore not a good methodology as it requires that the researcher lives with the subjects and observe. This is not compatible with the current research since it is practically not possible for the researcher to live with the communities.

### 3.5.3 Grounded Theory

Strauss and Corbin (1990) defined grounded theory as a theory which is discovered, developed and provisionally verified through systematic data collection and analysis of data pertaining to the phenomenon.

It is indeed a powerful approach when is known about a phenomenon. Silverman (2006) presents it in three stages as follows; first stage is to develop categories that illuminate the data, then second stage is saturation of the categories with many cases in order demonstrate their importance and the third stage involves devolving of the categories into analytical framework with relevance to outside setting. Unlike grounded theory where the researcher has few predetermined ideas, in the current research some idea is already available on impact of satisfaction on consumers; commercial literature confirms loyalty as one of the impact of consumer satisfaction. Grounded theory is therefore not applicable in the current research and will not be adopted for the research.

### 3.5.4 Multiple Case Study

Case study is an empirical inquiry that investigates a contemporary phenomenon with its real life context (Yin, 1993). According to Eisenhardt (1998) it is the best strategy especially when the focus is understanding dynamics in a single setting. Case studies therefore are powerful when an in-depth understanding of a phenomenon is sought.

Case studies are used as an integral component of the current research for the following reasons:

1) The current research is looking at a number of issues regarding consumer satisfaction and case studies have the capacity to have multiple dimensions of a subject to be studied exhaustively (Alavi and Carlson, 1992; Benbasat, 1987; Yin, 2002).
2) In order to find solutions to the challenges experienced with rural water supply it was imperative that a strategy used should illuminate facts and decisions, why they were taken and how they were implemented and Case studies does just that (Schramm, 1971).
3) The current research intends to answer explanatory “how” and “why” questions which is appropriate for case studies (Yin, 1994)
4) The researcher has little control over the events under study and in such cases Yin (1994) recommends case study as a viable research approach.

Case study sole practicality in a single setting prohibits generalization (Yin, 2003). The issue of generalizations is however very critical in the current research. Low sustainability is not

a single context issue rather it applies to many settings and requires generalization. Case studies are also known for bias (Gailiers, 1991) and Yin (2004) confirms that case studies have high levels of bias than other research strategies.

The observation highlighted above renders the strategy appropriate for the current research but with challenges because of the issue of generalization. However in consideration of this generalization weakness multiple case studies are used (Yin, 1994; Lee, 1989). Considering that sustainability of rural water supply is critical especially now when the focus is to make access to safe water a human rights issue then bias should not be tolerated as such in-depth understanding of every case will be sought to overcome the weakness. This observation confirms that case study is appropriate for the current research and much more the multiple case study used removes the weakness (Yin, 2003).

According to Bartunek, Rynes and Irland (2006) articles where theory is built from case studies often are reflected as the most interesting research. Anderson (1983) and Pinflield (1986) mean that scientists uses case studies to test theories. Kidler (1982) means that they are used to render description and Eisenhardt & Graebner (2007), Eisenhardt (1989), Solberg Soilen & Huber (2006), Harris & Sutton (1986), Gersick (1988) and Mintzberg (1979) mean that case studies are used to develop theory about different topics. The topics are according to Gilbert (2005) and Galunic & Eisenhardt (2001) internal organization, group process according to Edmondson, Bohmer & Pisano (2001) and strategy according to Mintzberg & Wlaters (1982).

Yin (2003) explains that one thing that needs to be taken into consideration when deciding to use case study methodology is the context. When a study includes more than one case then a multiple case study is needed. Indeed to research on factors that affect sustainability of borehole rural water supply systems then multiple case study is needed because an issue that impedes sustainability on one borehole may not be the issue affecting sustainability on another borehole as it is said by Harvey (2004) that there are a number of factors that affect sustainability of rural water supply.

Multiple case studies have the capacity to understand similarities and differences across multiple cases (Baxter and Jack, 2008; Stake, 1995). It is also possible to analyse data from within a situation and across situations (Yin, 2003). Multiple case study allow the researcher to augur contrasting results for expected reasons and augur similar results in the studies (Yin, 2003) this enables the researcher in clarifying whether the findings are valuable or not (Eisenhardt, 1991). In summary the evidence created from a multiple case study is strong and reliable (Baxter & Jack, 2008).

The cases that were used in the current research had to satisfy the following requirements and were sampled by random purposive sampling method:

1. The case was a borehole rural community water supply system.
2. The case had operated over a period of five years
3. Five cases of the ten cases were supposed to be adequately been supported by the consumers in ensuring that they are sustained.
4. Every administrative region of Malawi had to have at least 3 cases (northern, central and southern)

Ten borehole rural water supply systems were selected based on the understanding that 2 to 12 cases is a good number for multiple case study (Eisenhardt, 1989; Sekeran, 2000; Yin, 1994). The case studies enabled the process of understanding solutions and strategies used in combating challenges faced by rural water supply in Malawi.

### 3.5.5 Survey

According to Collins and Hussey (2009) survey is a method for collecting data in which a sample of respondents are asked a list of carefully structured questions chosen after considerable testing with a view of eliciting reliable responses.

Survey method was used in the research design in order to measure consumer satisfaction with the case studies. By doing that it was possible to confirm the factors identified as essential for sustainability. Structured questionnaire were used in a survey because they are efficient in gathering views from a large number of participants (Sun and Meng, 2009).

Surveys are an old methodology for conducting research and they are capable of presenting a precise map or precise measurement of potential. According to Sapsford (1999) they are a detailed and quantifiable description of a population. Surveys have the capability of generalization which is an attribute of a framework that is intended to be developed in the current research. The idea is by using this framework one should be assured of increased consumer satisfaction and presumably more loyalty and positive behaviour for sustainability of rural water supply.

Surveys are usually administered through a questionnaire and ably handle both open ended and closed loop questions. Gray (2004) says that descriptive surveys that use open ended questions have a capability of ascertaining attitudes, values and opinions whilst analytical surveys have the capacity to test a theory or approve a conceptual map by identifying the relationship between variables. They can be generalized in other contexts. The current research intends to identify a statistical relationship between input variables and consumer satisfaction; and ultimately understand how consumer satisfaction will impact sustainability.

Generalization of results is critical in the current research, as it intend to provide a solution to a global concern or issue and surveys capacity to generalize the findings makes it appropriate for the current research.

Quantitative data were collected through a survey, a choice that stemmed from the efficiency and prevalence of this data collection tool for learning about people and their behaviours (Bradburn and Sudman, 2004; Dillman, et al. 2009). With regard to the survey mode, participants were interviewed by research assistants who were carefully selected and trained. The main aim of the questionnaire's development process was to be easy for the respondents to understand. As Feilzer (2010, p. 11) highlights; "The implicit expectation is that survey respondents should comprehend the questions in the same way as the researcher does." Any unclear terminology is likely to produce biased estimates, thus, affecting a study's findings (Fowler, 1992). For this reason the questionnaire was kept simple and short, providing clear instructions and asking clear and short questions to eliminate any ambiguities (Brace, 2013).

The questionnaire consisted of four A4 pages. Questionnaires with an upper limit of four pages have been found to increase response rates (e.g. Yammarino, Skinner, and Childers, 1991). A short introduction informed the participants about who was conducting the survey and its topic. The main body of the questionnaire consisted of two sections: demographics and satisfaction measures on a Likert scale. The statement thanking participants for taking part in the survey was at the very end. This is a common questionnaire sequence, according to which, the researcher commences with unthreatening factual questions, moves to closed questions, and then to more open-ended questions (Cohen et al., 2011; Brace, 2013). Moreover, both the qualitative and quantitative phase questions had the general aim to capture information that could potentially facilitate the integration of data obtained from the surveys and semi-structured interviews, respectively, during the discussion stage of the results.

In order to check the appropriateness of the questionnaire in the specific context of the current research, a pre-test was conducted. Pretesting is an essential process in order to identify questions that are ambiguous or difficult for respondents to understand and to gain feedback about structural aspects of the questionnaire (e.g. instructions, layout, attractiveness, length, questions' format and so forth) (Reynolds and Diamantopoulos, 1998; Krosnick, 1991; Cohen, Manion, and Morrison, 2011).

The questionnaire was pre-tested among both experts and non-experts, namely, two water monitoring assistants, and five members of a rural community, who shared similar demographic characteristics with the research sample. The choice of participants was

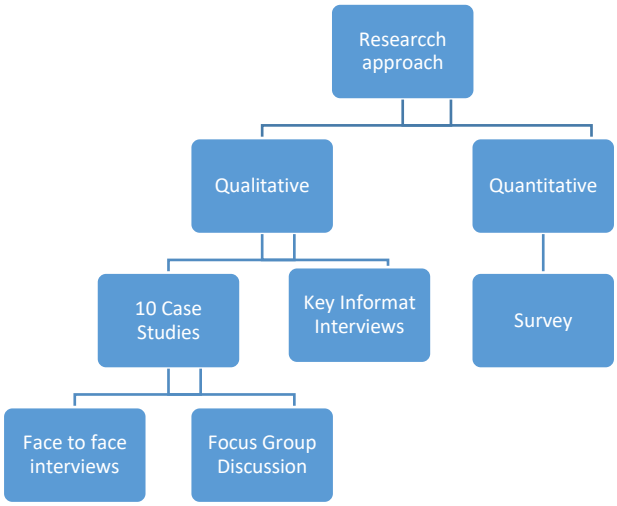
based on the need for experts' input, as they were more likely to identify errors in the questionnaire (Diamantopoulos et al., 1994), and simultaneously on the premise that the pre-test should use respondents similar to those of the target population to screen items for appropriateness (Hair et al., 2010, p. 655). The water monitoring assistants in particular, mixed expertise on the topic and shared characteristics with communities (e.g. they were integral parts of their communities). Face-to-face survey was used to conduct the pre-test. It has been found that such a personal approach to pre-testing is more likely to result in errors being detected than the impersonal administration (Reynolds and Diamantopoulos, 1998).

While the questionnaire was developed carefully in order to eliminate ambiguities and to be easy for respondents to complete, the pre-test results showed that issues with regard to wording and layout existed. More specifically, there was a consensus among all the participants in the pre-test survey that the wording in specific questions might be difficult for the target population to understand. As such, the language was carefully amended and kept as simple and straight forward as possible (Clark and Watson, 1995).

Considering the use of existing measures, and the conduct of pre-tests, the absence of a pilot study was not expected to affect the survey's validity and reliability. In addition, and given the relatively small total sample, the pre-test served as a proxy for a pilot study.

In summary the current methodological approach is pragmatic using a mixed approach strategy. Both quantitative and qualitative approaches are used depending on context. Survey, one to one interviews and focus group discussion were used. In order successfully roll out the strategy the researcher expounds on the qualitative approach and bring on board ten research case studies (water point/borehole cases) that were used during the research data collection. The researcher general methodological approach is going to take the shape below.

Figure 9: Summarised Methodological Approach of the Current Research




Source: Author

Figure 9 above presents the methodological approach of this research in terms of what constituted the quantitative methods and what constituted the qualitative approach. The quantitative method adopted use of survey for collection of data whilst the qualitative method adopted use of a multiple case study and key informant interviews. In addition face to face interviews and focus group discussions were used to collect data from the multiple case study.

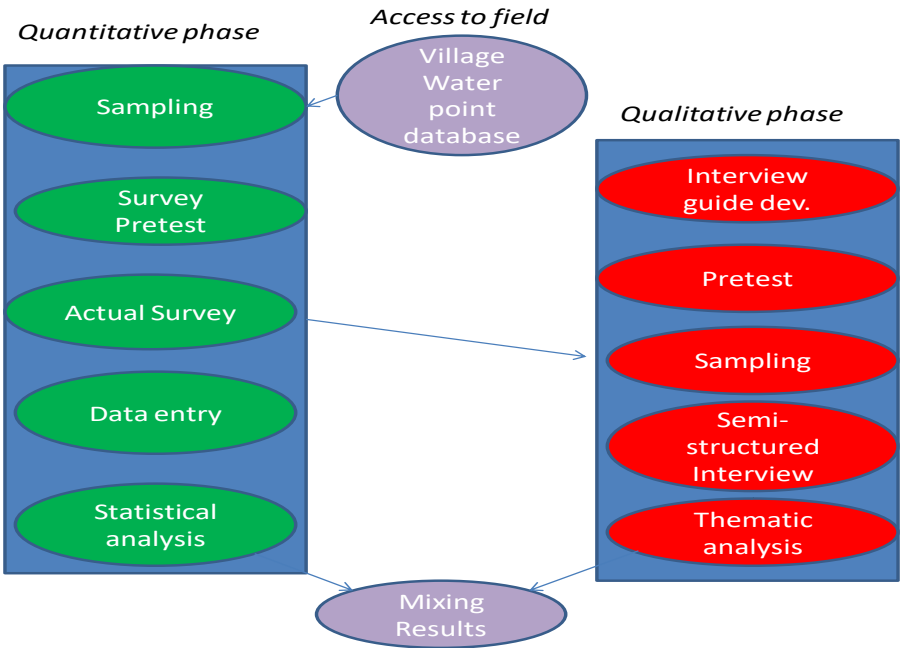
## 3.6 Sampling

The current research utilised multi stage random sampling technique. Firstly the targeted Ares Development Programs were random sampled to get the villages that could undergo the survey. The next stage was random sampling households who would undergo the survey and at the house hold the household head was targeted to go through the survey. Multistage sampling is a widely used sampling strategy in mixed-methods studies, regardless of the methodology's goals (Onwuegbuzie and Collins, 2007). Within the specific context of the current research, the choice of a sampling strategy was dictated by the characteristics of the target population, namely, community members who use water from a protected water source like a borehole.

For Key Informant Interviews then Purposive (non-probability) sampling was the appropriate sampling strategy under the current researches' specific circumstances and later followed by a random sampling approach. Through purposive sampling "particular settings, persons, or events are deliberately selected for the important information they can provide that

cannot be gotten as well from other choices" (Maxwell, 1998, p. 87). Such selection has been seen as a fundamental aspect of many social processes, and has been acknowledged as particularly useful in studies on special populations (Henry, 1990; Winship and Mare, 1992; Koch and Emrey, 2001). In addition, it can also be used in quantitative studies, despite arguments that equate it to qualitative studies (Onwuegbuzie and Leech, 2005). On the other hand, such a sampling technique entails risks regarding statistical inference and generalisability of results (Onwuegbuzie and Collins, 2007).

Figure 10 : Mixed Methods Design




Source: Teddlie, C., and Tashakkori, A. (2009)

Figure 10 on mixed methods design attempts to present the process adopted in the current research to achieve the objectives of using a mixed method approach. Main source of information is the village water points and that is where the respondents were sampled from. Similarly the sample for the qualitative study was taken from the sampled quantitative sample. Mixing and interpretation of results was done after analysis.

The current research depended on the local leaders' willingness to provide the researcher access to the target population and village water point usage data. Therefore, a more personal approach was essential in order for the researcher to create a relationship of trust with the key people within the community. Specific sampling issues for the quantitative and qualitative phases are discussed analytically in the respective sections of this chapter. What must be mentioned at this point is that the sample of the qualitative phase was not

necessary a subset of those individuals who participated in the full quantitative phase but focus groups from the same water points where the survey was conducted.

### 3.6.1 Description of Sample

In the current research all individual men, women and children in area development programme (ADP) that use a particular water facility formed a unit analysis of the current research. However for the focus group discussion six committee members were expected to be in discussion per water point. The number six comprised of three key executive water point committee members comprising of the chairperson, treasurer, secretary and three other committee members which comprised of ones who have been involved in any of the following; borehole repair, borehole fund raising or borehole sanitation or hygiene. For four focus group discussions it meant 24 water point committee members participated.

Respondents were sampled from 10 of the 28 districts of the three geographical locations of Malawi. Malawi is divided into geographical regions namely north, Centre and south. The respondents were sampled from World Vision ADP commitment areas; these commitment areas are locations where World Vision (a humanitarian and relief Christian organization) implements its relief and development work activities. The areas were targeted because the researcher was an employee of World Vision making the process of data collection easier.

### 3.6.2. Sample Size

The current research adopted a mixed method approach, the quantitative approach was used for individual respondents' data collection exercise whilst the other approach was a qualitative approach, combination of the two methods enabled triangulation of the findings. Multi-methodological approaches are widely desired because they provide a holistic perspective of world views, help provide a clearer picture of the social world and make for more adequate explanation of the social world (Maxwell, 1998).

The quantitative data was collected from 384 respondents. Focus Group Discussions were held as an instrument for getting qualitative community level data and information and 24 people participated.

The random selection of these respondents ensured that the sample is representative enough to allow for generalized findings. The formula for computing the sample size in each ADP was as follows:

Sample Size (SS) = $Z^2*(p)*(1-p)/c^2$

Where:

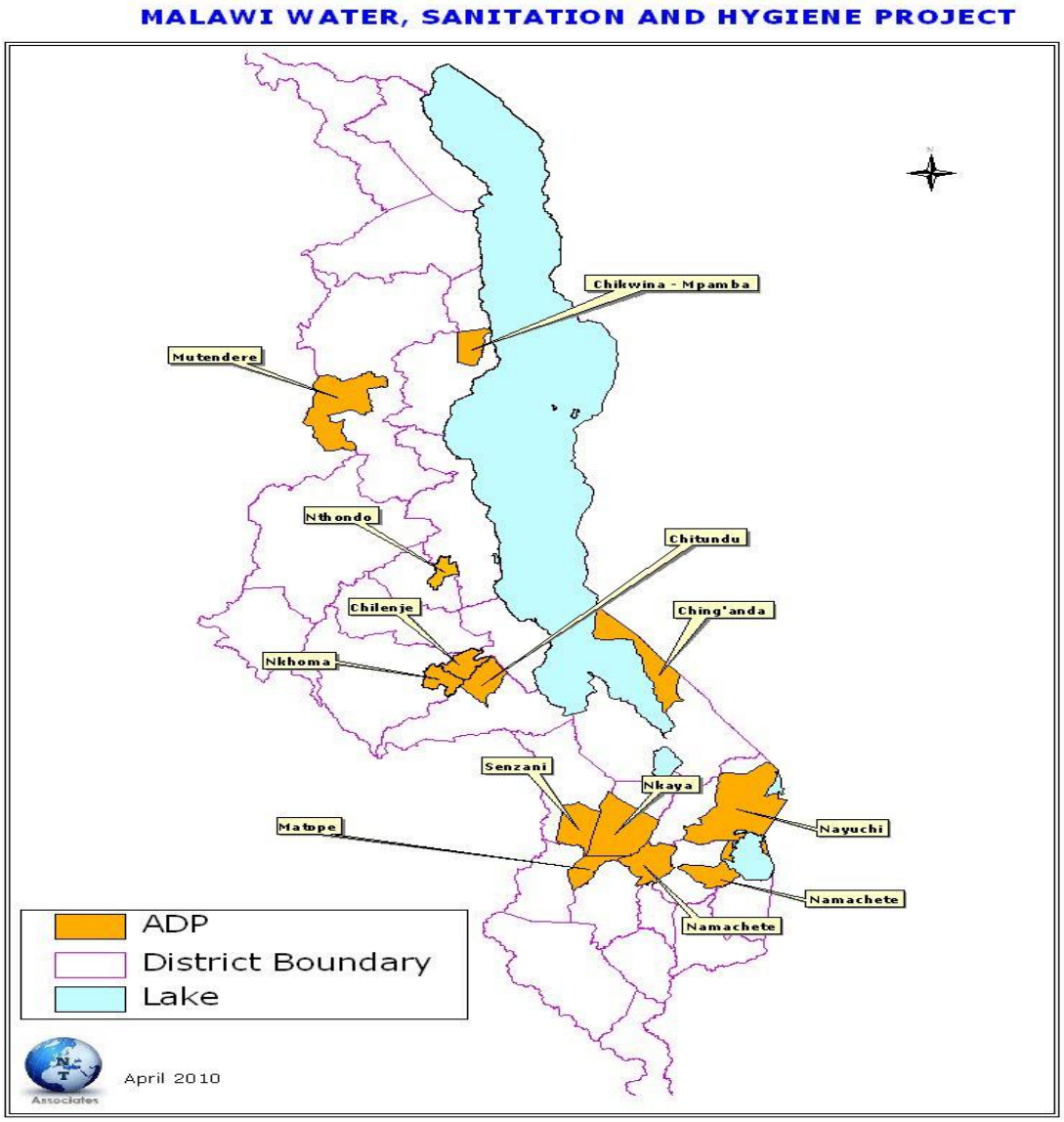
| | | |
|---|---|---|
| Z (95% confidence level) | = | 1.96 |
| P (percentage picking choice) | = | 0.5 |
| C (confidence interval) | = | 0.05 |

And:
Correction for Finite Population
New SS = SS/ (1+ ((SS-1)/pop)

The 384 respondents sample size for the survey was gotten from statistical calculation. The sample comprised mainly of women household heads whose large proportion walk more than thirty minutes round trip to collect water. These are the women and girls who take the burden of collecting water in sub Saharan Africa (Harvey, 2004). It is these women that are expected to raise resources for operation and management of the water supply as not many men are present in their neighbourhood. Sustainability of rural water supply hence depends on the women who also were targeted in the current research.

In order to ensure spatial differences in the location of respondents, purposively the researcher selected households located close, mid-way and those furthest to the water source from the randomly selected 10 households. The justification for this was to capture the aspect of accessibility and proximity to the water source of the intended interventions. Using a 5 per cent margin of error, equation generates a sample size of 384 respondents. This sample size is an acceptable sample size for larger populations as provided for Saunders et al. (2009) at 95% confidence level. Saunders et al (2009) agrees that 95% is good enough for most business and management research. Table in figure 9 below presents the sampling frame that was used for the current research.

Figure 11: Map Showing Sampled Locations under Current Research




Source: Author

Figure 11 above is a map showing distribution of research areas where data was collected across the whole country of Malawi. Research areas covered all administrative regions of the country and people of various cultures.

Table 6: The Current Research Sampling Frame (Quantitative Component)

| | Survey | Common Sustainability Challenges mentioned by over 50% of the respondents | | | |
|---|---|---|---|---|---|
| Name of ADP | $N_{ss}$[3] | Low quantity of water | Poor Quality of water | Frequent Breakdowns | Lengthy down time period |
| Mtendere | 31 | √ | × | √ | √ |
| Chikwina | 33 | √ | √ | × | √ |
| Nthondo | 19 | √ | √ | × | √ |
| Kasangazi | 33 | × | √ | × | |
| Chilenje | 30 | √ | √ | √ | √ |
| Nkhoma | 31 | √ | √ | √ | √ |
| Tchesa | 28 | √ | × | × | × |
| Sezani | 31 | √ | √ | √ | √ |
| Nkaya | 27 | × | √ | √ | √ |
| Ching'anda | 30 | √ | √ | × | × |
| Chingale | 29 | √ | × | √ | √ |
| Namachete | 32 | √ | × | √ | √ |
| Matope | 30 | √ | √ | √ | √ |
| Total | 389 | | | | |

[3] $M_{ss}$ = Satisfaction survey sample

Table 6 presents the challenges faced by each case study. The table 6 demonstrates how various elements of unsustainability affect various case studies demonstrating need to various sustainability prescriptions that would be used to manage challenges facing different boreholes.

## 3.7 Understanding Consumer Satisfaction Measurements

The relationship between need gratification and overall satisfaction reveals the existence of satisfiers, dissatisfies, critical, and neutrals. In the current research the functional relationship between attribute need fulfilment and overall satisfaction is investigated to determine if it is monotonic across the entire range of component variables of rural water supply. If one views need fulfilment as continuum ranging from “falls short of my needs” to “exceed my needs,” Maslow’s (1987) theory would predict a kinked curve with an inflection at the “meets my needs” midpoint. This means product whose performance in excess of meeting needs would be of modest utility to the consumer. Implying there is little gain from over designing products however as noted from Tracy (1986) some level of acceptable excess that presumably would provide the same level of modest utility as just meeting needs would be acceptable. This is critical as it assists in understanding the optimal design for rural water supply systems.

Need fulfilment dates back to Murray (1938), Maslow (1943) and McClelland (1955) works and others. Their discussion on product-usage need fulfilment however doesn’t deviate significantly from discussion of basic physical, psychological and social need themes where these needs or sometimes called motives are assumed to be innate. In other words needs are viewed as instrumental in the satisfaction of innate drives. Human need satisfaction just as employee need satisfaction models are to some extent an extension of Maslow’s (1943) theory of human motivation and deprivation-gratification thinking and is widely used as a measure of satisfaction.

An analysis of Maslow’s (1943) original work on human motivation brings out a major issue on response of an organism to individual needs and that is what is now known as deprivation-gratification. Although Maslow’s focus was on motivation it is clear from his work and that of other early researchers that fulfilling needs, deficiencies, or values contributed to satisfaction.

Generally, these techniques of measuring satisfaction appear to be less than ideal. The critical incident technique is limited to those factors of evaluation associated with extremes and is a nominal measure. Kano et al.’s (1984) functional and dysfunctional technique represents an ordinal scale (at best) transformed into a nominal scale (one-dimensional,

attractive, etc. classification) only after dropping factors that do not cleanly fit into the available categories. Therefore, the data collected through these two techniques are not suitable for model testing analysis. So, what is needed is a truly interval-scaled index, which may be used in more powerful statistical analyses.

Data would be collected through interviews designed from need gratification understanding. Based on this literature discussion interviews are a preferred instrument for achieving the objective of exploring various determinants of satisfaction in rural water supplies. Silverman (1985) notes that interview data display realities, which are neither biased nor accurate, but simply 'real'. Kvale (1996) also advocates the interview method to seek and describe the meanings of central themes.

The first research question is about on establishing the role of the consumer in rural water supplies. Literature review failed to clarify properly roles of the consumers or end users in rural water supply. In the current research the researcher needs to establish the role of the consumer in the Malawian context. This demands asking open questions where the users have to explain their roles and through an analysis the roles can classified. Considering the type of response anticipated then the qualitative method was appropriate. This research question also needs further explanation as such it is necessary not to confine consumers to what is identified in literature but rather allow them to speak up on what they perceive to be their role; and rank which one is the most critical role. This type of response cannot be adequately answered through a range of options that are provided quantitatively thereby making the qualitative response very important for both triangulation and in depth revelation of the other roles of the consumer.

The second research question attempts to identify the pillars that support sustainability of a borehole system rural water supply. In the research by Ungwe (2015) a number of pillars for piped drinking water systems were identified this research builds on that to cover the borehole rural water supply system thereby in combination providing a holistic picture of rural water supply sustainability. Literature review has models and approaches presented in its technical jargons however in practice there are a few practical things that matter in order to have a sustainable rural water supply. It is important that the pillars that have been identified through a synthesis of literature are confirmed to be true before putting to test the conceptual model. Since the researcher has the preconceived options of responses at hand then pursuing this research question deductively through a structured questionnaire is the preferred approach thereby making the quantitative approach the first option to tackle research question number two however qualitatively similar issue will appear where the

researcher will be able to know if even more pillars exist and try to add them into the current research.

This researcher is coming with a literature background that consumer willingness is a stark marker of poor operation and maintenance (Montgomery et al., 2009). Satisfaction is also presented in literature review as an antecedent to positive behaviour (Oliva, 1999). The researcher intends to unpack the issues behind consumers' dissatisfaction and unwillingness to own the water supplies. The researcher does this through a series of satisfaction related questions.

Research question three intends to provide answers to issues on determinants of consumer dissatisfaction. The overall focus of the current research is to attest overall consumer satisfaction to rural water supply sustainability as such considering why consumers are satisfied or dissatisfied with water supply services or attributes is considered paramount. Water supply can be looked at from various perspectives as follows; management perspective, access perspective and quality perspective. The management perspective is about management models and approaches, the access perspective is about issues on functionality and down time period (time taken to bring back the broken down water system into functionality), the quality perspective is about how safe water is for human consumption and this can be looked at from the chemical and biological contamination angles. The quality perspective is not very emphasized in the current research because the research is being done on protected water points that are assumed to be sources of safe water. A qualitative approach was found to be appropriate for research question number three where respondents in their own words are given the opportunity to explain what makes them satisfied or dissatisfied with the water facility.

Contrary to unsatisfied consumers who are presumed to be mostly associated with unsustainable water supplies; it is a sustainable water supply which is supposedly associated with satisfied consumers. This researcher attempts to understand the statistical effect of rural water supply sustainability pillars on overall satisfaction of the consumers. Further to that the researcher tries to establish the statistical relationship between consumer overall satisfaction and consumer behaviour which is essential for sustaining the water facility. This is answered through responses to question four of the current research. A quantitative approach that allows conducting cross tabulations, establishing correlations and comparisons of means is the preferred approach of data analysis.

Research question five is the core of the current research and it concerns development of a satisfaction based framework for stimulating behaviour essential for sustainability of rural water supply. Establishing statistical prediction is the main aim of research question five

and this is better done through a regression analysis of the relevant data. This was necessary to establish the extent of prediction and explanation of the change in the dependent variable that is caused by the independent variable. Qualitatively understanding effects of dissatisfaction and satisfaction of the consumer is necessary as it firmly connects satisfaction to sustainability and also assists in better explaining the impact of consumer satisfaction and dissatisfaction on consumer behaviour.

## 3.8 Quantitative Data Collection

Questionnaire is one of the most widely used data collection techniques within the survey strategy (Saunders et al., 2009) and it provides an efficient way of collecting responses from a large sample prior to quantitative analysis. The questionnaire can ably be designed to allow respondents to drive and describe the content within the boundaries of the formulated research questions. Many like (bell, 20015, Oppenheim, 2000) argue that it is hard to produce a good questionnaire and that the design of the questionnaire can affect reliability and validity of the data, however Saunders (2009) says validity and reliability can be improved by carefully designing the questions, a clear and pleasing layout of the questions, lucid explanations of the purpose of the questionnaire, pilot testing and a carefully planned and executed administration.

### 3.8.1 Data Collection Procedure

Data for the current research was collected from the project areas where the large scale Malawi water, sanitation and hygiene (MWASH) project that is being implemented by World Vision International. This enabled administering of the questionnaire to a wider audience in shortest time possible. It reduced the non-response rate to zero, leverage resources for data collection at the same time allowed the organization to have full access to research findings and use recommendation in its operations; World Vision strategic mandate for financial year 2012-2015 was being a customer focused organization and the current research was a perfect fit to the strategic focus of World Vision Southern Africa region.

All communities in the targeted areas were informed of the pending survey and requested to avail themselves through village chiefs 21 days prior to the survey. The survey instruments used in this baseline survey were translated from English to Chichewa (national local language in Malawi) for ease of use with the rural, mostly semi-literate or illiterate informants. Field enumerators and supervisors were trained to carry out the survey in Chichewa (local language). During training, both English and Chichewa language versions were read out aloud and the Chichewa version was fine-tuned. Training on the survey instruments was conducted over two days from 25$^{th}$ to 26$^{th}$ April 2012. The training included

the reasons for the survey, survey methods and techniques, and technical handling of each question. Before undertaking a pre-test of the instruments, the research assistants interviewed one another in the vernacular language so as to maintain the original English concepts and requirements of the questions. Pre-testing of the questionnaire was done in Chiwamba area in Lilongwe district, which is the rural area of the capital city of Malawi. After training and pretesting, the team made necessary modifications to the translated versions of the instruments.

The survey was conducted in sampled villages in 12 of the 28 districts of Malawi namely Nkhatabay, Mzimba, Dowa, Ntchisi, Lilongwe, Salima, Mangochi, Dedza, Balaka, Ntcheu, Neno, Zomba district (Refer figure 11 and table 6 of the current research). It also involved working with key heads of institutions/organizations including the District Director of Planning and Development (DPD), District Water Development Officer, District Environmental Health Officer (DEHO), Primary Education Advisor (PEA), Headmasters/Headmistress, Health Surveillance Assistant (HSA) and Chairman of Area Development Committee. The data collection team consisted of 28 research assistants subdivided into four groups. Each team had six research assistants and one supervisor.

## 3.9 The Qualitative Aspect of the Current Research

The qualitative phase of the current research addressed research questions 1, 3 and 5 including the development of the framework itself. This qualitative phase also helped to shed more light into the results of the quantitative phase (Robson, 2002) as the research questions are interrelated. Therefore, this flexible design was essential as it allowed for achievement of in-depth insights; it also provided adequate interpretations with regard to the current research overall results.

Going back to the wider assumptions of mixed-methods research and the use of triangulation, Morgan and Smircich (1980, p. 498) indicate, that “quantitative techniques may have an important but only partial role to play in the analysis and understanding of the process of social change; however, their utility is much more restricted in more subjectivist positions”. Such techniques cannot capture the complexities of individual human behaviour, thus, flexible qualitative designs appear to be more appropriate (Lincoln and Guba, 1985; Robson, 2002; Flick et al., 2004). Such designs “can provide thick, detailed descriptions of actual actions in real-life contexts that recover and preserve the actual meanings that actors ascribe to these actions and settings” (Gephart, 2004, p. 455). In addition, qualitative approaches give particular emphasis on situational and structural contexts (Strauss, 1987). In other words, the use of a qualitative design aimed to capture a more holistic picture of

the phenomena under study (Crabtree and Miller, 1999). Despite all this explanation on choice of qualitative research as a preferred methodology, the current research adopts a pragmatist stand as such it was more of the appropriateness of a research methodology to respond to a specific research question that mattered than a philosophical stand.

### 3.9.1 Method of Data Collection and Interview Guide Development

Data were collected through interviews, a primary qualitative approach to understanding others (Fontana and Frey, 2003). According to Patton (2002, p. 341), "Qualitative interviewing begins with the assumption that the perspective of others is meaningful, knowable, and able to be made explicit. We interview to find out what is in and on someone else's mind, to gather their stories." Thus, the interview allows us to understand subjective meanings (Flick, 1992) by taking seriously the notion that people are experts on their own experience and so best able to report how they experience a particular event or phenomenon (Darlington and Scott, 2002), by providing true and accurate pictures of themselves and their lives (Denzin and Lincoln, 2003).

As a consequence, interviews have the potential to provide rich and highly illuminating material (Robson, 2002). In addition, interviewing is a powerful data collection strategy as it uses one-to-one interaction between researchers and interviewees. This interaction gives the interviewer the opportunity to clarify topics or questions and ask for explanations of vague answers (through prompts) (Cohen et al., 2011).

Open-ended interviews, in particular, allow respondents to express their own understanding in their own terms, which may lead to a reconceptualization of the issues under study (Patton, 2002, Teddlie and Tashakkori, 2009). Among the three main approaches of data collection through open-ended interviews, the informal conversational interview (unstructured interview), the general interview guide approach (semi-structured), and the standardised interview (Patton, 2002; Denzin and Lincoln, 2003), the semi-structured interview was chosen. Taking into account the specific aspects of the current research, and acknowledging that each approach has strengths and weaknesses, the semi-structured interview was considered as the most appropriate choice. This decision was dictated by the following specific reasons:

a) The current research needed to combine the strength of both unstructured and structured interviews and thus making semi structured interviews appropriate :
b) The researcher want to retain a form of structure that gives the questions a logical sequence and also makes the process of interviewing more controllable and flexible for the interviewer, as the interviewer is guided by the schedule and not dictated by it as recommended by (Smith, 1995; Patton, 2002);

c) The researcher is looking for rich data and it is only a flexible approach that would do that. This flexibility can provide rich data as it applies both to the researcher and the respondent. The researcher is free to follow up (probe) interesting topics that emerge during the interview, and the respondent is able to give a fuller picture (Smith, 1995; Kvale and Brinkmann, 2009; Cohen et al., 2011)
d) The cross sectional and mixed-methods character of the current research was incompatible with the use of an unstructured or a structured approach. The former would fit better in a pure qualitative study, and the latter in a study that had not already used another structured approach to data collection (survey).

On the other hand, as with every research tool, the interview has its disadvantages. For instance, it is not a neutral tool of data collection but an active interaction between people, which leads to negotiated results (Fontana and Frey, 2003), the researcher used his interviewing skills to being neutral as possible in order to avoid bias in the current research, and the interview guide helped this. The interview situation is influenced by the personal characteristics of the interviewer, including race, class, ethnicity, and gender (Denzin and Lincoln, 2003) and the researcher acknowledges these challenges as such a good brief about the research is done before the interview starts. Another disadvantage concerns the inconvenience it may cause respondents as it requires a considerable commitment of time on behalf of them, and often their willingness to talk and reflect on deeply personal experiences (Darlington and Scott, 2002) and the researcher avoided this by ensuring that appointments were done at least two weeks before the date of the interview to ensure that respondents plan their time well before the interview. In addition, the interview may not fully protect their anonymity (Cohen et al., 2011) as a result, such issues may be perceived from potential interviewees as disincentives to participate, especially when a research focuses on vulnerable populations and sensitive topics and the researcher avoided this by simply not taking down the respondents' names.

With regard to the structure of individual research questions, each semi structured question had more than one part; the first was the main question, and the second included probes. The first part was linking conceptually each interview question to the research questions, and simultaneously was opening the discussion on the topic of each question in an easy way for the respondents, trying to keep a balance between too open and too closed questions.

Although too open questions may elicit long and rich narratives, and are significant in successful in-depth interviewing (Bernard and Ryan, 2010), this rather applies to respondents who are more talkative, and it can 'block' those who are not. For this reason a

more gradual approach to interviewing was preferred. After opening the topic of each question, the second part of the question built upon the flexibility that the semi-structured interview gave the interviewer, which allowed for frequent use of descriptive probes. Probes are essential in shedding more light into aspects of the phenomena under study (Patton, 2002). In fact, descriptive probes were used as the means through which the phenomena under study are both explored and explained. As Darlington and Scott (2002, p. 57), among others, point out, "descriptive questions about what and how things happened are particularly useful in encouraging people to describe their experiences." In addition, such questions give the freedom to the interviewee to express whatever they want to say without any restrictions (Patton, 2002). Depending on the richness of the answers given, second probes were used when necessary, asking the interviewees if there was anything else they wanted to add.

The interview-guide comprised of eight questions, including an opening and a closing question). The first and second question are introductory questions, aiming to open the conversation in an easy way for the interviewee and to establish rapport and understanding what consumers understand about sustainability of rural water supply. Interview questions 3 and 4, aim to identify any roles of the consumer and any additional roles that consumers feel could be vital for sustainability of rural water supplies. Question 5 aims at identifying the pillars of a sustainable water point and how their absence affects the feelings of the consumer. Questions 6 and 7 aim at identifying the root causes of problems that fail the sustainability pillars and proposals on how to manage the root cause problems. Question 8 aims at identifying the outcome of satisfaction on rural water supply sustainability.

The interview-guide was pre-tested on a face to face interaction in Chiwamba village in Lilongwe District, the rural area of the capital city of Malawi depending on what was more convenient for the participants, and resulted in a positive feedback suggesting minor changes with regard to the length and wording (ambiguity) of some questions. Such questions were simplified and tailored to the everyday language of the respondents (Kvale and Brinkmann, 2009; Cohen et al., 2011), leading to the final form of the interview-guide.

### 3.9.2 Qualitative Sampling

Similarly to the quantitative phase, purposive sampling was also used in the qualitative phase of the current research; however for different reasons. More specifically, purposive sampling within the qualitative phase's context had two equally important aims: to select those individuals who represented as closely as possible the broader group of cases, and to select, if possible, information rich cases (Teddlie and Yu, 2007; Teddlie and Tashakkori, 2009).

In total, twenty four individuals were interviewed; eight males and sixteen females, with ages ranging from 26-50 through four focus group discussion. Although achieving typicality of individuals is not the main aim of qualitative research, it gives confidence that the conclusions represent adequately the average members of the population, (Maxwell, 1998; Flick, 2006). The current research targeted all the key positions in a water point committee thus chairperson, secretary and treasurer, it also targeted three more members of the committee who are involved in actual repair of the borehole, management of sanitation and hygiene around the borehole and fundraising for the borehole. The following positions were preferred because they play a critical role in operations and management of the borehole, gender balance was achieved by ensuring that for every male participant there were two female participants, this was simple to achieve because already there are more females in water point committees than men.

With regard to the sample's size this was perceived as adequate given that purposive sampling typically picks a small number of cases (Teddlie and Yu, 2007). Twelve interviews have been found to be enough to achieve data saturation (e.g. Guest, Bunce, and Johnson, 2006). Similarly, and within psychological research, in particular, Morrow (2005, p. 255) asserts that "the *magic number* 12 is as good as any, when necessary to predict sample size." Of course, the adequacy of sample's size also depends on the chosen analytic method. Braun and Clarke (2013, pp. 48-50), for instance, recommend for patterned-based methods of analyses (e.g. thematic analysis, interpretative phenomenological analysis, grounded theory) 6-10 interviews for a small project, 10-20 for a medium, and 20+ for a large project. In general, and depending on the methods of data collection and analysis used, recommendations about sample size vary (see Onwuegbuzie and Collins, 2007, pp. 288-289). In the current research the sample size of 24 participants is perceived to be adequate as it doubles the recommended sample size of 12 and is also well gender balanced.

Notwithstanding the focus of qualitative researchers on sample size, this is not to say that the sample size exclusively determines data saturation. Data saturation depends on data quality and depth, and on the variety of evidence (Morrow, 2005).

### 3.9.3 Focus Group Discussions

All the twenty four participants were interviewed through focus group discussion. Some interviews took place in the participants' homes and water points. The average duration of the interviews was 45 minutes excluding briefing and interviews were audio recorded and then transcribed verbatim. Key informant interviews were also conducted and these took

place at an appropriate place chosen by the interviewee many chose that the researcher finds them at their homes and some in their offices.

The role of power in interviewing was taken into serious consideration, given that the majority of participants were females. The relationship between the interviewer and the interviewee is typically conceived of as a hierarchical one, where the interviewer holds a position of power, when interviewing people who occupy societal positions of lesser power (see Braun and Clarke, 2013, pp. 88-89). As such, interviewing across gender (e.g. male researcher and female participant) and social differences may result in some participants feeling uncomfortable to disclose personal and often sensitive information. The gender difference was managed through a good brief before the interview.

### 3.9.4 Method of Analysis: Thematic Analysis

Qualitative research is a diverse field, not based on a single or unified theoretical and methodological concept (Patton, 2002; Flick, 2006; Denzin and Lincoln, 2008; Silverman, 2013). Among a plethora of qualitative analytic methods, which in practice involve similar stages (Darlington and Scott, 2002), thematic analysis was chosen for the analysis of semi-structured interviews. In general, thematic analysis can be defined as "a method of identifying, analysing and reporting patterns (themes) within data, which capture something important in relation to the research question and represent some meaning within the data set" (Braun and Clarke, 2006, pp. 79-82). But analysis is also synonymous with data interpretation (Strauss, 1987), and the same applies to thematic analysis. While "a theme at minimum describes and organises the possible observations, at maximum interprets aspects of the phenomenon" (Boyatzis, 1998, p.4).

Searching across a data set to find repeated patterns of meaning is a fundamental and generic process of text analysis that can be used with most qualitative methods (Boyatzis, 1998; Darlington and Scott, 2002). Depending on the method adopted, social scientists use different terms for themes, with the most common of this called *categories*, used by grounded theorists (see Bernard and Ryan, 2010). This common process that thematic analysis shares with other analytic forms of qualitative analysis renders it a foundational qualitative analytic method, as it provides core skills useful for conducting these other qualitative analysis methods (Braun and Clarke, 2006; Guest et al., 2012). This common process has been also resulted in the notion that thematic analysis is not a specific qualitative method (e.g. Boyatzis, 1998). It is often used without being specifically named as the method of analysis and it is usually claimed as something else (e.g. grounded theory or discourse analysis), when, in actuality, numerous researchers use thematic analysis (Gephart, 2004; Braun and Clarke, 2013). Although it has been long viewed as a poorly

'branded' method, more recently has been recognised as a distinctive analytic method (Braun and Clarke, 2006). Yet others prefer the term *style of interpretation* (see Willig, 2012), which has been also applied to other analytic methods, such as grounded theory (see Strauss, 1987).

The appropriateness of thematic analysis within the context of the current research stemmed from its flexibility, and, thus, its consistency with the general pragmatic approach of the current research as a whole. Thematic analysis focuses on identifiable themes and patterns of living and/or behaviour (Aronson, 1994). Among its competencies is cognitive complexity (Boyatzis1998), which means that the complexity of psychological concepts can be better revealed with a method that can potentially provide a rich and detailed account of data (Braun and Clarke, 2006, p. 78). For such reasons, thematic analysis is among the main qualitative analytic methods within psychology and social psychology (Crotty, 1998; Stainton Rogers, 2011). Thematic analysis is relatively unique in that it only provides a method of data analysis, and it does not prescribe methods of data collection, theoretical positions, and epistemological or ontological frameworks (Braun and Clarke, 2006, p. 178). For this reason, it offers the flexibility that is necessary for the exploration and interpretation of complex psychological and social phenomena, such as the phenomena under the current research, and it can be applied across a range of theoretical and epistemological approaches (Stainton Rogers, 2011). In other words, the theoretical freedom of thematic analysis does not mean that thematic analysis is a theoretical, but rather that this freedom gives it the flexibility to combine theoretical approaches when this is required (Willig, 2012).

Moreover complex social psychological phenomena cannot be captured through the lens of pure naturalistic or constructionist theoretical approach. The former focuses on the factual characteristics of the object under study, but overlooks how people create meaning in their lives (phenomenology), while the latter emphasises that facts are socially constructed particular environments or contexts (Wertz et al., 2011, Silverman, 2013). Thematic analysis on the other hand, acknowledges the ways individuals make meaning of their experience and the ways the broader social context impinges on those meanings (see Braun and Clark 2006, p. 81). Thematic analysis represents what Wertz et al. (2011, p. 83), call "innovative and fruitful methods" that can develop without much attention to complex philosophical issues. In contrast, other analytic methods, such as interpretative phenomenological analysis or grounded theory, which also seek patterns across a data set, are theoretically bounded (Braun and Clarke, 2006).

### 3.9.5 Root Cause Analysis

The researcher conducted four focus group discussion and twelve key informant interviews where a root cause analysis was conducted. The idea was to identify the root causes of rural water supply sustainability challenges and also propose solutions. The data set collected had information on root causes of the sustainability challenges and probable solutions. The whole idea behind identification of root causes of sustainability challenges was to comprehensively address the problems as root cause analyses enables such (Dew, 1991; Doggett, 2005).

## 3.10 Quality Assurance

For quantitative data, at the end of each day the team discussed data collection issues that had arisen on that day. In addition, the supervisors checked the questionnaires for errors and consistency and assigned serial numbers to all completed questionnaires. Quantitative data were entered in CSPRo, cleaned and analysed with the Statistical Package for Social Scientist (SPSS) version 20.0 for Windows.

The current research credibility was ensured through a “prolonged engagement” in the field, regular meetings with people in rural communities during the fieldwork, and the use of methodological and theoretical triangulation (Lincoln and Guba, 1985; Patton, 2002). With regard to the quantitative phase of the current research, measures that have been widely used in social studies, and have been found to be reliable, valid, and efficient within the contexts of user satisfaction, were chosen (Epel, Bandura, and Zimbardo, 1999; Chen, Gully, and Eden, 2001; Scherbaum, Cohen-Charash, and Kern, 2006; Hoeppner et al., 2011).

With regard to the qualitative phase of the current research, attention was paid to issues of transparency, subjectivity and reflexivity, and negative case analysis. The analytic process was explicitly articulated in order to become as clear as possible how research was undertaken and how data were transformed into results (Lincoln and Guba, 1985; Gephart, 2004; Braun and Clarke, 2006). All the above processes ensured the current research trustworthiness (Morrow, 2005), trustworthiness was also enhanced by ensuring that random sampling was done in choosing which water committee was to be targeted for a focus group discussion. By having a large number of participants in the focus group discussion individual viewpoints and experience were verified against others and ultimately a rich picture of the attitudes, needs or behaviour of those under scrutiny were also constructed based on contributions of a range of people (Lincoln and Guba, 1985).

The utilization of purposive sampling increased the likelihood of the results' transferability (Teddlie and Yu, 2007) meaning the results of this situation can easily be applied in a similar situation and yield similar results. The context of the current research is a rural setting served with a rural water supply which predominantly is a borehole. Boreholes generally in Malawi have a water point committee and display similar characters in terms of composition and gender as it is well guided by government policy. The results of the current research can therefore be easily transferred to settings resembling the one of the current research.

Validity is generally concerned with the meaningfulness of research components (Lincoln and Guba, 1985; Patton, 2002), when researchers measure behaviour they are concerned with whether they are measuring what they intended to measure. Similarly the current research was challenged on its validity and the researcher avoided this by asking two senior expert in the field of rural water supply to review the semi structured interview guide before going for interviews. A few things were corrected as per comments from the experts review and a corrected version of the guide was produced and used.

As stated by Lincoln and Guba (1985) a dependable study needs to be accurate and consistent and that stepwise replication and inquiry audit are the best ways of evaluating dependability of data. The researcher achieved dependability by adding on the research team another experienced researcher to conduct two focus group discussions as the researcher conduct two other focus group discussions and compare the results, this is an approach that ensures dependability of results through stepwise replication. The researcher also allowed the other research experts to examine the research plan and execution to ensure that there is consistency of findings of the research.

## 3.11 Ethical Considerations

Ethics in social research revolve around such issues as "How should we treat the people on whom we conduct research?" (Bryman, 2008). Within the context of the current research ethical considerations had a fundamental role. Both the surveys and the interviews included questions about personal issues like literacy levels etc. As such, it was acknowledged that while the main goal of each research project is to find credible answers to its questions, such answers are only acceptable if they ensure the well-being of the participants in the study (Darlington and Scott, 2002; Creswell, 2003).

Consistent with this principle, the current research conformed to the research ethics of the University of Bolton, and the relevant social research guidelines (e.g. Heberlein and Baumgartner, 1978; Mertens, 1998; Bradburn et al., 2004; Kvale and Brinkmann, 2009; Teddlie and Tashakkori, 2009; Cohen et al., 2011; Brace, 2013). This involved:

a) The researcher had a brief before every interviews on focus group discussion and this meant informing participants about the purpose, the content, the successive stages of the research, and the benefits from participation;
b) The researcher in the process tried to explain in detail what was expected from the participants and how their responses would be used;
c) The researcher emphasized the voluntary nature of participation, their right not to answer any particular question, and their right to withdraw from the current research at any time and for no reason,;
d) The researcher ensured that a clear written declaration was presented to the participants and this ensured participants' anonymity, and their right for privacy;
e) Similarly it was presented by the researcher to the participants that any data identifying participants will remain confidential while the current research is in progress, and that it will be destroyed after the current research is completion;

## 3.12 Data Analysis

Despite the sequential character of data collection, in terms of chronological order, the two data sets were analysed in parallel or independently. This type of analysis is among the most widely used analytic strategies in mixed-methods research and has been associated with triangulation and convergence (Teddlie and Tashakkori, 2009; Creswell and Plano Clark, 2011). In the current research triangulation was achieved through use of different methodologies to support interpretation of the other and also it was achieved through various means of data collection like interviews and observation especially during focus group discussion. Data was collected and analysed in parallel however data collected from either methods was also used to help interpret results of a research question even though it is the research questions that necessitated adoption of a particular methodology as a pragmatist.

Quantitative data collected from the respondents of the current research was analysed with the help of SPSS 20. This was done on data from households that use improved water sources in the current research areas. The statistical tests were applied to check variations and central tendency and variations in data. From the survey data, relationships for each category were derived to determine each of their elements and the effect on the overall satisfaction of the consumer. This was then linked to functionality of the water point. In analysing the survey data, several statistical tests were applied. However, since the data in this satisfaction survey is categorical data, the most appropriate data test was to check relationships and variations.

More specifically, data analysis involved two separate processes, namely, quantitative analysis of surveys using descriptive/inferential statistics for the appropriate variables, and qualitative analysis of semi-structured interviews, using thematic analysis (these strategies are presented analytically in the presentation of results chapter). After the qualitative and quantitative analyses were completed, the results were mixed during the overall interpretation stage specifically for each research question. As such, although the two sets of analysis were independent, each provided an understanding of the phenomena under investigation (Teddlie and Tashakkori, 2009).

## 3.13 Conclusion

This methodology chapter presented the methodological approach of the current research, as this was guided by the philosophical assumptions of pragmatism and the requirements of the research questions. The chosen mixed-methods design and its two separate quantitative and qualitative components were described analytically along with practical aspects of the research process, such as ethical considerations, sampling issues, and access to the target population. 384 respondents participated in a survey; four focus group discussions with 24 participants; twelve key informant interviews; numerous face to face interviews and observations were conducted alongside a multiple case study. This was an introduction to the empirical part of the current research that follows in the presentation of results chapter. Chapter 4 presents the analysis and results of the survey and semi-structured interviews.

# CHAPTER 4: RESEARCH FINDINGS

## 4.0 Introduction and Overview

Chapter three detailed the methods used to address the research questions introduced in section 2.6 of chapter 2. The purpose of the research findings chapter is to present the results obtained following quantitative and qualitative data analysis. The results presentation follow the research questions sequence and are in five sections. The first section deals with roles of various stakeholders and most specifically the role of the consumer. The second section is on the pillars of a sustainable rural water supply and introduces consumer satisfaction as paramount condition for stimulating desired consumer behaviour essential for rural water supply sustainability. The third section deals with determinants of consumer dissatisfaction and how can that be managed; this section unearths the root causes of consumer dissatisfaction and proposes means of managing the challenges. The forth section is on consequences of failing to manage consumer satisfaction and how that affects entire sustainability of rural water supply. The fifth section is on development of the consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi.

## 4.1 Analysis Strategy

The current research adopted a mix method by use of surveys, focus group discussions, interviews with key informants and observations. The analytic strategy comprised of three different processes; namely, the identification and management of root causes of consumer satisfaction challenges, identification and examination of the impact of rural water supply sustainability pillars and other attributes on consumer overall satisfaction, and impact of consumer overall satisfaction on consumers behaviour. In the current research, desired consumer behaviour is presented in three forms of 1) effective community demand, 2) local financing and cost recovery, and 3) dynamic operation and maintenance (Montgomery et al., 2009).

The quantitative part involved related measures and exploration of relationships. With regard to the choice of specific statistical techniques, both parametric and non-parametric statistics were used. This was dictated by the different measurement type, metric (interval) and non-metric (nominal and ordinal), of the dependent variables (Hair et al., 2010).

The qualitative part of the current research used a thematic analysis method. This part followed a hybrid process of inductive and deductive thematic analysis which was consistent with the wider pragmatic approach of the current research. The qualitative phase of the

current research involved manual coding, analysis of the audio recorded interviews and identification of themes within a data set.

The current research aimed at achieving the following research objectives (RO);

a) RO 1 -To establish the role of the consumer in rural water supply sustainability success
b) RO 2 - To identify pillars of a sustainable rural water supply;
c) RO3 -To establish reasons behind rural water supply consumers' dissatisfaction with their water supply
d) RO 4 - To determine the impact of consumer satisfaction on consumer behaviour in rural water supply
e) RO 5 -To develop a framework for enhancing consumer satisfaction with rural water supplies in Malawi

## 4.2 Quantitative Approach

### 4.2.1 Data Analysis Procedure

Exploration of the research questions required the collection of data from rural water consumers. The data was statistically analysed in order to answer the research questions. The purpose of this analysis was to ascertain whether the independent (sustainability pillars) statistically predicted change in the dependent variable (overall satisfaction) and if overall satisfaction led to any statistical change in the outcome dependent variable (sustainability). Consumer satisfaction is measured on the product and that is water itself, indicators for the sustainable water supply in the current research are functionality (frequency of breakdowns) and downtime period (time taken to repair a water supply problem) and activeness of management.

### 4.2.2 Statistical Tests Employed within the Current Research

*4.2.2.1 Descriptive Statistics*

Descriptive statistics do what they say: they describe, so that researchers can then analyse and interpret what these descriptions mean (Cohen, Manion and Marrison, 2011; 622). Descriptive statistics should be reported as they clearly communicate results to the reader (Wright, 2004; 133), and contribute to the exploration of experimental outcomes through their role in calculations regarding the magnitude and direction of experimental effects. The mean and standard deviations are reported for those data sets relevant to each research question, with descriptive statistics provided for each condition and overall sample.

*4.2.2.2 Inferential Statistics*

Inferential statistics differ from descriptive statistics in that they consider the ability to generalise findings from a sample to wider populations (Dancey and Reidy, 2011; 43). The current research design, research questions, experimental hypotheses and type of data must all be considered when deciding which statistical analyses may be most appropriate (Cohen, Manion and Morrison, 2011; 697). A statistically significant result would be acknowledged if the probability of a 'Type I error' and the probability of the result being obtained by chance was less than 5% ($p<0.05$) (Dancey and Reidy, 2011; 141).

4.2.2.2.1 Parametric Tests

Parametric tests provide one such means of obtaining inferential statistics from which experimental conclusions may be drawn. However, it should be noted that parametric tests make certain assumptions about the total population from which a study sample is drawn (Dancey and Reidy, 2011; 154). These assumptions relate to population characteristics or 'parameters', including: The data used should be at least interval level;

(i) The data should be normally distributed (section 4.2.2.3.1);
(ii) The variances of the population(s) should be relatively equal (section 4.2.2.3.2).

It was therefore important to undertake preliminary analyses to ensure that these assumptions were met by the data sets obtained in the current research (section 4.2.2.3). Parametric tests are commonly used within psychological research because they provide a higher level of statistical power and a greater ability to identify a statistically significant relationship between variables, should one exist.

4.2.2.2.2 Non-parametric Tests

Conversely, non-parametric or 'distribution-free' tests do not make certain assumptions about the data collected and are therefore considered as alternative statistical analyses, which may be used when those assumptions underpinning parametric tests cannot be met (Dancey and Reidy, 2011; 528). Non-parametric tests were considered if those assumptions in section 4.2.2.3 were not met.

*4.2.2.3 Preliminary analyses*

It was necessary to undertake a number of preliminary analyses of the data obtained, to ascertain whether this data met those essential assumptions underpinning parametric tests. The checks undertaken are detailed below.

4.2.2.3.1 Tests of normality

Parametric tests work on the assumption that the data set is normally distributed. The Shapiro-Wilk test was used to test this assumption; a non-significant result ($p>0.05$) suggests that the data set is normally distributed, whilst a significant result ($p<0.05$) indicates that a data set is non-normally distributed (Razali and Wah, 2011; 21) and interpretations may lack reliability. If the data was non-normally distributed then non-parametric tests.

4.2.2.3.2 Tests of Equality of Variances

Parametric tests also assume that the variances of the populations of interest are approximately equal (Dancey and Reidy, 2011; 155). Levene's test of Equality of Variances was used for each research question, to ascertain whether the variance of anxiety scores were comparable. If the assumption of homogeneity of variance is violated but a study boasts equal numbers of participants in each condition then parametric tests may still be employed, albeit with cautious interpretation and on the basis that the other assumptions listed were met. If these conditions could not be met, then non-parametric tests were considered.

4.2.2.3.3 Tests of Equality of Means

In comparison studies, it is important to establish the extent to which the conditions are comparable, or homogenous with regards to the dependent variable, prior to the independent variable being manipulated. Independent t-tests compare the mean performance of participants from differing conditions (Brace, Kemp and Snelgar, 2012; 120)

4.2.2.3.4 Regression Analysis

In statistical modelling, regression analysis is a statistical process for estimating the relationships among variables. The investigator seeks to ascertain the causal effect of one variable upon another. This analysis will separate causations from prediction thereby help the researcher in modelling the impact on one variable upon the other.

## 4.3 Qualitative Approach

Qualitatively, data was obtained via focus groups discussions and face to face interviews undertaken with water point committee members and key informants in the ten research case studies. This section aims to describe the qualitative analyses undertaken on the data obtained via the focus group discussions conducted within the current research. A focus group discussion qualitative data collection method was used within qualitative phase and a six-phase guide to Thematic Analysis (Braun and Clarke, 2006).

### 4.3.1 Data Included Within the Qualitative Analysis

Participants from the same localities where the survey took place (n=24) were invited to attend the focus group session, which considered the following research focus:

*"An exploration of participants' perceptions of their roles as water consumers, consumer dissatisfaction and its root causes including solutions of managing the same, and consumer views on how satisfaction impact sustainability".*

Each session lasted for forty five minutes and was conducted by two researchers.

The following sections describe the steps used in Thematic Analysis used for qualitative guide questions 1-8 (Appendix 2). FG discussions were voice recorded, and the audio recordings were then transcribed by the researcher in order to provide the written data necessary for the Thematic Analysis. The analysis was recursive in nature, whereby "movement is back and forth as needed, throughout the phases" (Braun and Clarke, 2006; 86) in order to refine the analysis process.

Familiarisation with the Data Set

The researcher must first gain familiarity with their data set by immersing themselves within the data (Braun and Clarke, 2006; 87). This was achieved by the researcher listening to the audio recordings, before transcribing them.

As this analysis sought to provide a rich description of the entire data set across the four focus group discussions, some depth and complexity may be lost in favour of an analysis of the overall data set (Braun and Clarke, 2006; Boyatzis, 1998). Braun and Clarke (ibid) argue that this is often the case when exploring an under-researched area, such as participants' perceptions of the impact of satisfaction and dissatisfaction on rural water sustainability. After transcription, the entire data set was read several times and interesting patterns noted.

Generating Initial Codes

The process of generating initial codes followed. Codes represent “the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon” (Boyatzis, 1998; 63). Provisional codes were developed through repeated reading of the data set, and extracts of note were numbered on the basis of the code they potentially represented; all data should be coded in some respect at this stage (Braun and Clarke, 2006; 89). These extracts were then transferred to post-it notes. Where necessary, additional information was included within these notes, to ensure that the extract made sense out of context.

Identifying Themes within the Data Set

A theme may be defined as: “something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” (Braun and Clarke, 2006; 82).

Following coding of the data set, the researcher then began identifying salient or common themes within the data (Attride-Stirling, 2001; 392. Other codes encompassed a high volume of data across a number of participants and were therefore considered to be a theme in their own right. At this stage seven themes were identified within the data as follows:

1. Roles of the consumer
    a. Critical roles of the consumer
2. Pillars of sustainable rural water supply
3. Determinants of consumer satisfaction
4. Root causes of consumer dissatisfaction
5. Managing root causes.
6. Effects of consumer satisfaction on consumer roles
7. Effects of consumer dissatisfaction on consumer roles

The researcher then illustrated these themes within a graphic and noted the codes contributing to each theme. As part of the recursive nature of the familiarisation process, it was then necessary to revisit the data set to ascertain whether the extracts and initial codes were representative of the proposed themes.

Reviewing the Themes

This stage required the researcher to revisit the initial themes and reconsider whether these themes remained representative of the 'overall picture' of the data, or whether some themes required some refinement. At this stage themes may be combined or further subdivided depending upon the apparent trends within the data.

The researcher then sought to establish overarching themes, designed to encapsulate collections of themes within the data.

Naming and Operationalising Themes

This phase seeks to operationalise each theme and provide each theme with a final label. The aim here is to articulate the 'essence of what each theme is about' (Braun and Clarke, 2006; 92) and to ensure that each theme is mutually exclusive.

Consideration should also be given to the 'keyness' of each theme i.e. the extent to which that theme contributes to the overall story of the data set and the initial research questions. The prevalence of the theme (i.e. the number of times the theme is apparent within the data) is not a sole determinant of the 'keyness' of a theme and it could be argued that establishing 'keyness' on the basis of frequency may be misleading, given that some individual participants reiterated similar points within the entire data set, thereby increasing the prevalence of that theme. The researcher considers the prevalence of a theme in terms of the number of participants making reference to that theme, as opposed to solely acknowledging the number of times a theme is apparent within the overall data set.

### 4.3.2 Analysis Strategy

The current research qualitative phase followed a hybrid process of inductive and deductive thematic analysis which was consistent with the wider pragmatic approach of the current research. Flick (2006) define hybridization as the pragmatic use of methodological principles and avoidance of restricted subscription to a specific methodological discourse thus acknowledging that real world research is never purely inductive nor purely deductive (Bernard and Ryan, 2010). The advantage of the hybrid approach to thematic analysis was that it allows to draw upon a "priori" issues (those informed by the original research aims and introduced into the topic via the topic guide), emergent issues raised by the focus group discussion (FGD) participants themselves, and analytic themes arising from occurrence or patterning of particular views and experiences (Ritchie and Spencer, 2002).

Analysis was performed manually for two reasons; firstly, the qualitative phase of the current research had a character of a study within a mixed method project, which made manual

coding manageable, and secondly, manual coding offers the analyst the best possible sense of the data and more control over the analytic process (Saldana, 2009, p.22). Before proceeding with the analysis the audio recorded interviews were transcribed verbatim (Seale and Silverman, 1997). Although transcription is a preparatory step of the analytic process, it has been often perceived as the very first step for the identification of themes within a data set (Bernard and Ryan, 2010)

### 4.3.3 Analytic Process

The first step involved careful and repeated listening of data recordings, and reading all transcripts several times in order to gain an overview of the collected material and to get familiar with the data (Ritchie and Spencer, 2002). This was an intensive and active process which also included pre-coding, namely circling, highlighting and colouring important text segments, keeping notes, and shaping the first ideas about potential meanings and patterns within data (Braun and Clarke, 2006; Saldana, 2009). This process had a strong focus on the research questions and the related literature (Schmidt, 2004). In addition these first ideas comprised the basis for the production of the initial codes during the next step of the analytic process.

This analytic stage was a combination of within case and cross case analysis. In both types of analysis, the frequency of different word occurrences was counted in order to identify key areas that form the basis of the analysis (Crabtree and Miller, 1999).

With regard to the coding strategy, initial coding employed descriptive coding. Descriptive coding is applied to assign labels. This is a fundamental part of the analytic process, as it allows for close scrutiny of the transcripts, and initiates the discovery of themes (Strauss, 1987; Bernard and Ryan, 2010). Descriptive is mainly deductive, focusing on the research questions and theoretical knowledge. Codes were generated deductively and inductively; however the themes finally produced were, to a large extent, influenced by the relevant literature (Boyatzis, 1988). Different codes were sorted into potential themes, and relevant quotes were attached to these initial themes (Braum and Clarke, 2006). Themes were revised, and checked several times before taking the final form.

Interpretation refers to the attempt to see the analysed data and their meaning in some larger context (Ely et al., 1997). During this process data extracts are treated both illustratively and analytically, a combination that reflects the flexibility of thematic analysis (Braun and Clarke, 2006). The illustrative approach provides a description and interpretation of the theme, and inserted quotation are used as examples of the analytic points raised (Braun and Clarke, 2013).

It must be stressed at this point that, similar to everyday conversation, interviews do not elicit the same amount and quality of information from all people engaged in the interview conversation. This said, it is common in research that utilizes qualitative interviews, some participants were more talkative and provided richer information than others (e.g. Hunter-Jones, 2005).

### 4.3.4 Interviewees' Profiles

The sample's characteristics are coherent in terms of literacy, occupation and geographical location to some extent, the sample comprised a diverse group of age and gender. This diversity was reflected in the variability of data, which are presented in this chapter, and can be perceived as an advantage in qualitative research (Wertz et al., 2011). The focus group sample characteristics composed of the three executive members of the water point committee and the three other members of the committee.

### 4.3.5 Qualitative Results

This section presents the results from the semi structured interviews and is divided into three main parts. The first part is related to knowledge and conscience of the Focus Group Discussion (FGD) participants on their role as consumers (See photo 4 below); the second is about determinants of consumer satisfaction or dissatisfaction in rural water supply; the third part is related to the expected behaviours of a consumer and how consumer satisfaction affects them. All these parts focus on satisfaction; what brings and affects satisfaction, and how satisfaction affects behaviour of the consumer.

Photo 4: The researcher Peter Matipwiri (far right) in a discussion with Water Point Committee members of Malayina Borehole

Overall the results showed that roles of the consumer subscribe to the desired user behaviours depicted by Montgomery et al., (2009). The current research also found that consumer satisfaction is paramount for the desired consumer behaviours to be performed. The current researches' qualitative phase also identified problem root causes to consumer's dissatisfaction; the qualitative phase also managed to identify effects of both consumer dissatisfaction and consumer satisfaction. Consumer dissatisfaction is one of the major factors that hold back the consumer from performing the desired behaviours essential for sustainability of rural water supply. Secondly it is found that consumer satisfaction is complex as it is affected by many factors and moderators that need to be cautiously observed and managed when rolling out rural water supply projects.

## 4.4 General Survey Findings

### 4.4.1 Social Economic Characteristics of Respondents

The descriptive statistics of the social demographics characteristics of the sample are presented in table 7 below. The original categories were based on a theoretical background and aimed to capture more detailed demographics and to produce a picture that presents a true reflection of a rural Malawian set up. This was necessary to check the samples' representativeness.

Table 7: Socio Demographic Characteristics of the Sample

| Variables | Values | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| Gender | Male<br>Female | 94<br>290 | 24.5<br>75.5 | 24.5<br>100 |
| Age | Male (mean) = 41.56 years<br>Female (mean)=51.43 years<br>Child (mean)=16 years | | | |
| Education | Adult literacy[4]<br>Primary<br>Secondary<br>Tertiary<br>Illiterate | 2<br>249<br>71<br>3<br>59 | 0.5<br>64.8<br>18.5<br>0.8<br>15.3 | 0.5<br>65.4<br>83.9<br>84.6<br>100 |
| Water source | Borehole<br>Tap<br>Protected dug well<br>Unprotected dug well<br>River /stream | 382<br>0<br>13<br>28<br>2 | 89.9<br>0<br>3.1<br>6.6<br>0.5 | 89.9<br>89.9<br>93<br>99.5<br>100 |
| Average walking Distance (D) to source | Less than 500m<br>Between 500m & 1km<br>5km< D > 1km<br>> 5km | 282<br>77<br>23<br>2 | 73.4<br>20.1<br>6.0<br>0.5 | 73.4<br>93.5<br>99.5<br>100 |
| Maintenance efficiency history | 1-48 hours<br>2-14 days<br>14-30 days | 74<br>74<br>23 | 37.9<br>37.9<br>11.8 | 37.9<br>75.9<br>87.7 |

[4] Adult literacy refers to education system specifically designed for illiterate adults who would want to learn how to read and write in Malawi

| Variables | Values | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| (measured by down time) | > 30 days | 24 | 12.3 | 100 |
| Management status | Community based water committee<br>Rural Private Operator model<br>Public Private operator<br>Community leaders | 149<br>4<br>2<br>40 | 76.4<br>2.1<br>1.0<br>20.5 | 76.4<br>78.5<br>79.5<br>100 |

Table 7 above has enabled reflection on several key themes like 1) who is the consumer as per population sample and gender of respondents? 2) What is the education level of the consumer and what does that entail? 3) How much time and what distance do they cover in collection of water? By analysing the demographic data in Table 7 above the researcher is able to explain in detail who the typical consumer is and likely challenges the consumer faces in rural water supply sustainability.

a) Description of the Population and Sample

The current research population comprised of rural water consumers regardless of type of water supply and this meant household heads and the people living in those households. According to the sample calculation 384 households were interviewed. The sample comprised of 94 male headed and 290 female headed households. According to the respondents due to urbanization, impact of HIV/AIDS and divorce many households are found to be headed by females than males there by justifying the compositions of the survey respondents.

b) Gender and age distribution of household head

Data from the survey shows that about 24.5% of the households in the current research are male headed and 75.5% are female headed. The mean age of male was 41.56 years whilst that of women was 51.43 years.

c) Educational status of household head and respondent

Household heads were asked to state their highest formal education level. About 15.3% of respondents reported that they have never been to school. Of the respondents who had been to school, 64.8% had done primary school, 18.5% had attended secondary school, 0.5% had attended adult literacy classes, and 0.8% attended post-secondary school education.

d) Access to sustainable safe water

The proportion of households generally accessing safe drinking water is at 93%, the main sources of safe drinking water is the borehole with a hand pump at 89.9 %. A good

proportion (7.1%) of the community still does not have access to safe water such that they collect water from unprotected dug wells or the river. In terms of sustainability all the water points had some issues regarding functionality, down time and activeness of management with varying degrees of severity.

e) Distance to the water source

Despite that 93% access safe water only 73.4% access the water within a recommended walking distance of less than or equal to 500m. The remaining 26.6% walk more than a distance 500m to collect water.

f) Water facility functionality and maintenance history

Forty nine percent (49%) of the boreholes did not breakdown in the past six months whilst 45.1 percent had broken down up to ten times in the past six months; about six percent had broken down more than 10 times in a period of six month. In relation to the functionality history is the time it takes to have a water point repaired/down time period; only 37.9% of the respondents have their water point fixed or repaired within 48 hours, about a similar proportion of the respondents (37.9%) have a downtime of 2-14 days; 11.8% have a down time period of 14-30 days and almost 12.3% take more than 30 days to repair a water facility signalling challenges that need to be sorted out.

g) Water facility management

A large (76.4%) proportion of the water points are managed by the community themselves with 20.5% being managed by the community leaders like chiefs. Only a few (3.1%) water facilities are managed by other models of management like the Private operator model (2.1%) and Public private operator model (1%).

In summary the typical consumer for the current research is a low literate (primary school) singly living village woman of a mean age range of 40-60 years. Almost 27% of these women walk more than 500m to collect water meaning they spend more than 30 minutes to collect just a 20 litre bucket of water. The typical consumer collect water from water facilities that have experienced signs of unsustainability in terms of continuous availability of adequate safe water though in varying severity levels. The impact of this finding reveals likely challenges that may be faced due to low levels of consumer understanding (low literacy) and low levels of consumers` disposable income.

### 4.4.2 Demographics and Situation Analysis of the Case Studies

The current research has 10 research case studies. All the ten research cases were analysed against the service level performance indicators to determine the level of satisfaction of the consumers. Sustainability is analysed in three dimensions of functionality, down time and management and these presents the three aspects of sustainability that are under study in the current research as presented by Harvey (2011) and these are the aspects that make the consumer satisfied as they depict the service level performance of a rural water supply system like the borehole. Table 8 below presents the service level performance indicators (SLPIs) and state of consumer satisfaction with the individual research cases.

Table 8: Comparison of Service Level Indicators and Consumer Satisfaction with Rural Water Supply.

| Case | | Down time Period | | | | | Functionality | | | | Existence of active Management | Level of satisfaction of the majority population | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 24 hrs | 48 hrs | 7 days | 14 days | >14 days | Never | 1-10 times | 11-20 times | >20 times | Yes/No | Very Satisfied | satisfied | Neutral | Not Satisfied |
| Case 1 | | | √ | | | | | √ | | | √ | √ | | | |
| Case 2 | | | | | √ | | | √ | | | | | | | √ |
| Case 3 | | | √ | | | | | | √ | | √ | | √ | | |
| Case 4 | | | | √ | | | | | √ | | √ | | | √ | |
| Case 5 | | √ | | | | | | √ | | | √ | √ | | | |
| Case 6 | | | | | √ | | | √ | | | | | | √ | |
| Case 7 | | √ | | | | | | | √ | | √ | √ | | | |
| Case 8 | | | | √ | | | | | √ | | | | | | √ |
| Case 9 | | | | | | √ | | √ | | | | | | | √ |
| Case 10 | | | √ | | | | | √ | | | √ | √ | | | |

Table 8 above shows that there is a pattern in both consumer satisfaction levels and the service level performance indicators of the boreholes in the research cases. As presented in table 8 above in general all the water points show signs of sustainability challenges the

only difference is the extent of unsustainability, similarly consumers also show varying levels of satisfaction in relation to the SLPIs. For instance some interviewees classify water points found to have downtime between 0-24 hours as sustainable and those with down time >14 days are classified as unsustainable. Water points that had 1-10 times breakdowns in the past six months were classified by respondents to be more sustainable than those with breakdowns >10 times in every six months. Any water point without an active management system in place is classified as unsustainable.

Why are Some Service Level Performance Indicators Failing in Some Research Case Studies?

Qualitative data of the Boxes (1-3) below assist in explaining why some SLPIs are failing:

Box 1: Why does it take more time to fix a water supply problem at the borehole than the recommended 48 hours?

"…we don't have a water point committee to take care of the borehole so it is difficult to know who will do what..."

"…this borehole supplies little water as such only a few people are interested in fixing it when broken down…"

"…there are too many break downs on this borehole and sometimes we lose interest so we use other surrounding wells..."

"…all members that were trained in fixing these problems are not in this village..."

"…the problem is big and we haven't raised enough funds for fixing the problem..."

Box 1 presents a number of themes that emerge as reasons for delayed fixing of water supply breakdowns within the recommended time of 48 hours like 1) Absence of an active management; 2) Inadequate capacity of the water infrastructure in producing adequate water 3) Lack of trained technicians or repairers and 4) Funding challenges

Box 2: Why does the borehole rural water supply break down more often?

"…we use poor quality products because they are cheap..."

"…there is no proper water point committee in fact the chief fix the borehole himself so no ownership as all.."

Box 2 presents a number of themes as reasons for frequent break downs of the borehole as: 1) Poor quality construction work and 2) Absence of trained water point committee.

Box 3: Why do rural water supply boreholes don't have an active management system.

"…the old members relocated to other areas and as such our water point committee has no trained member..."

"…they were tired of borehole breakdowns and they naturally dropped off..."

"…community members don't contribute and as a result the water point committee did not see reason of continuing..."

Considering that presence of an active and trained water point committee is repeatedly mentioned as a challenge then the researcher probed further to understand why there is absence of active and trained water point committees and the responses are in box 3 above. In general respondents mention 1) Migration of water point committee members and 2) Frustration as a result of offending consumer behaviour and non-functionality of the water system.

Analysing quotations in boxes 1- 3 above it shows that some problems are high level challenges whilst some factors are root challenges. The failing SLPIs of a borehole rural water supply facility is found to have six high level themes/challenges that emerge. These themes are the structural pillars that support service quality performance of a rural water supply as presented below:

1. Inadequate quantity of available ground water (Hydrogeological pillar)
2. Inadequate capacity to supply adequate water (Construction quality pillar)
3. Inadequate capacity to provide quality water (Water quality pillar)
4. Inadequate technical capacity to Operate Maintain and Manage (Technical capacity pillar)
5. Lack of financial resources (Financial pillar)
6. Lack of Trained members of the water point committee (Management pillar)

## 4.5 Roles of the Consumers

Bearing in mind the six structural pillars of sustainability the researcher tries to understand the role of the consumer in supporting sustenance of these pillars. Research question

number one looks at the role of the consumer. The roles are found under the following sub themes that are developed from the qualitative data below:

1. Providing financial resources and support
    a. Cash contribution
    b. Fundraising
2. Executing water facility related assignments
    a. Water facility sanitation and hygiene works
    b. Collection of stones, sand and bricks for construction of water point
3. Operation of the water system

During the focus group discussion a majority of the FGD participants commented that they are expected to contribute financial resources before and after construction of the water point to support operation, maintenance and management of the water facility. Quotations of the respondent's comments are provided in Box #4 below in support of financial contribution as a role of a consumer.

Box 4: Quotations that Support Provision of Financial Resources as a Role of the Consumer

*"…when the borehole breaks down we ensure that every family contributes money for maintenance…"*
*"…we contribute money every month…"*
*"…the community contribute funds for repair…*"
*"…having a fund is the most critical issue to avoid long breakdowns…"*
*"…all these roles are important but financial contribution towards maintenance of the borehole is very important…"*
*"…we need to continue our fundraising through community tasks like gardening in someone's field at a fee…"*
*"…we need to establish borehole revolving funds…*"

From box #4 above it is clear that contribution of financial resources is strongly presented as one of the key roles expected of the consumer. One FGD participant comment highlighted how funds availability avoids long downtime periods of a borehole when it breaks down. Another FGD participant also commented on the same but on a slightly different approach raising "creative and innovative ways" of fundraising as an important role of the consumer.

The focus group discussion also revealed that consumers are expected to execute various assignments related to the water facility; almost all FGD participants commented on hands on execution of various water point assignments as a role of the consumer. Quotations in support of this role are presented in Box #5 below:

Box 5: Quotations Supporting Execution of Various Water Point Assignments as a Role of the Consumer

*"…in the morning we tell them (consumers) to clean the water point"*
*"…in the morning there is need to clean the water point…"*
*"…it is necessary that the consumer clean the water point…"*
*"…community need to start contributing by collecting sand and stones…"*
*"…it is necessary that the community takes part for instance starting to put together resources like sand…"*
*"…we contribute materials to show our commitment…"*

As per quotes in Box 5 above another role of the consumer is hands on execution of various activities requested of the consumer by the water point committee or water point governing body. For instance cleaning the water point is one of the expected activities of the consumer; collection of stones and sands for construction of the borehole is another hands on assignment that is expected of the consumer.

The third role of the consumer that emerge from the interviews is operation of the water system. Whilst the role of operation management of the water facility is with the water point committee but the actual operation in terms of utilization is with the consumer. Consumers are trained and cautioned against abusive operation of the water facility.

Box 6: Quotations supporting Proper Operation of the Water System as a Role of the Consumer

*"…we (community members) don't allow children on the water point because they don't know how to operate the water system…"*
*"…they (community members) are expected to utilize the water system reasonably and in so doing many people learn how to operate properly…"*
*"…water committee can't be here (meaning at the water point) always. We (meaning the consumers) have a duty to protect the borehole from operation abuse…"*
*"…abusive operation of the water system leads to premature damage to the water facility…I think as end users we have a duty to protect the water facility from abuse…"*

As per the qualitative interviews quotes above it is found that four items have emerged as the roles of the consumer.

1. Financial contribution for operation, maintenance and management of the water facility
2. Hands on execution of demanded assignment of the water point.
3. Water point operation
4. Contribution of materials required for the water point

In summary Boxes 4-6 show that consumers responsibilities are more about the following pillars of sustainability 1) Financial pillar, 2) Water quality pillar and 3) Management pillar.

Roles of the Water Point Management Committee

The qualitative interview revealed a number of roles of the water point management committee. Box 7 below presents respondents quotations on various roles of the water point committee (WPC).

Box 7: Quotations on Roles of the Water Point Management Committee

*"…the committee repairs the small problems of the borehole… major problems need to wait for the mechanic…"*
*"…we (WPC) take the leading role in ensuring that the borehole is repaired once it breaks down..."*
*"…we (WPC) were here yesterday inspecting and cleaning the inside parts of the borehole..."*
*"…we (WPC) teach the community on how to operate the borehole to avoid premature breakdowns…"*
*"…so we (WPC) buy spare parts…"*
*"…we (WPC) ensure that consumers follow the rules like adhering to time of using the borehole…"*
*"…we (WPC) were trained not to allow children play on the water point….they abuse the facility and break it down…"*
*"…we (WPC) ensure that every family contributes money when the borehole breaks down…"*
*"…yes, we (WPC) ask the community to contribute…"*
*"…we (WPC) link with them (stakeholders) to ensure all is done well and that they have the information they look for…"*

*"…we (WPC) assign the household to do the water point cleaning and check if they have indeed done the cleaning otherwise we have ways to penalize those that do not do their work…"*
*"…we (WPC) don't allow children because they don't know how best to operate the borehole…"*

The quotations in box #7 above show that there are specific roles that are expected of the water point committee and that when such roles are not well performed the committee is deemed inactive.

1. Do minor repairs of the water point
2. Set up rules for management of water point
3. Source water point spare parts
4. Source support for water point maintenance
5. Train users on water point operation
6. Reinforce the rules of the water point
7. In charge of the water point
8. Lead in maintenance

Many FGD participants commented that maintenance of the water point is a responsibility of the committee however there is a limit of expectation since the respondents expect the water point committee to physically do minor repairs only whilst with major repairs the respondents expect the WPC only to lead in the process of getting the water point mechanic. On water facility maintenance, the respondents also expect the WPC to conduct preventive maintenance of the water facility. The respondents expressed that it is expected of the WPC to train the consumer on how to operate the water point facility. It is also expected of the consumer to manage the process of procuring spare parts. The WPC is also empowered to make guiding rules and laws and reinforce them, this is in consideration that the water facility is used by many consumers and without governing rules then abuse is prone to happen. Much as the users are expected to contribute financial resources for operation and management of the water facility it is also expected of the WPC to solicit financial resources for the borehole by reinforcing the governing rules of the water facility and leading in fundraising.

It is established from the interviews that in general terms committee members are the ones who are expected to be linking with stakeholders. The WPC is given the mandate to supervise community assignments performed at the water point otherwise social sanctions

will be applied for non-compliance. The borehole water point committee also has a role of safe guarding the borehole from abusive operation.

The critical Role of the Consumer

The qualitative phase of the research also revealed that some roles of the consumer are deemed more important than other roles. For instance when asked what is the most important role of the consumer as far as sustainability is concerned almost all FGD participants said that financial contribution towards operation and maintenance is the most important role of the consumer.

Box 8: The Most Critical Role of the Rural Water Supply Consumer

*"…having an active borehole fund that community are much willing to contribute is the most critical role of the consumer…with availability of funds we quickly respond to problems and avoid lengthy break downs…"*

The following roles of all roles of the consumer were identified by participants as the most important or critical roles of the consumer in order of ranking:

1. Financial contribution for operation, maintenance and management of the water facility
2. Hands on execution of demanded assignment of the water point.
3. Water point operation

In summary the major role of the consumer is the willingness to contribute towards operation, maintenance and management a water supply facility (Financial Capacity Pillar) whilst the major role of the water point management committee is to manage the water point facility (Management Pillar) and its consumers by providing guidance and leadership roles (Technical capacity pillar).

## 4.6 Themes of a Sustainable Rural Water Supply

Research question number two intended to identify themes behind sustainability of rural water supply. From research question number one it has been found that the underlying factor for rural water supply sustainability is the consumers' willingness to operate, maintain and manage the water supply facility.

Literature review too shows that there is one major key for sustainability of rural water supply and that is "willingness of the consumer to operate, maintain and manage (OMM) a water

supply" in other words unlike the urban water supply and other piped water drinking water services; the rural water supply/borehole relies on the consumer for its sustainability; it is a responsibility of the rural water supply consumer to actively and positively act for sustainability of their water supply.

Respondents quotations supporting the fact that their rural water supply / borehole is not sustainable because the consumer is not willing to operate, maintain and manage their water supply is overwhelming and presented in Boxes 9 - 10 below and thus substantiating the fact that "willingness to operate, maintain and manage a water supply rests in the consumer"

Box 9: Quotations Substantiating Motivation of the Consumer as Key for Sustainability of a BRWSS

| |
|---|
| "…for the management committee to fix a break down them need contributed funds to buy spare parts..." |
| "…it is the community that clean the surrounding of this borehole..." |
| "…the most important thing is availability of financial resources and we rely on the water users to collect this money..." |
| "…one community member bought this lock for us to use on the borehole..." |
| "…it all depends on support from the community, if the community is not willing to support then what can the committee do…" |

Box 9 shows that for sustainability to occur then a motivated consumer is paramount in particular the motivated consumer is needed in supporting activities and contributions for sustainability of the water supply system. The challenge then is to understand why consumers are not motivated to support sustenance of the water supply system.

Why are the Consumers not willing to Operate, Maintain and Manage the Water Facility?

In order to understand the root causes of the unwillingness to operate, maintain and manage a borehole rural water supply system; reasons were solicited from the interviews carried out in the cases studies and an analysis conducted.

Box 10: Quotations Presenting Why Consumers are Unwilling to Operate, Maintain and Manage a BRWSS

"…we rarely have water from this borehole so why should we contribute..."

"…there is no water as you can see throughout summer time and as such we see no reasons to contribute…"

"….I stopped contributing because I don't use water from this well for much of my domestics needs as it is very far…"

"…we need a trusted management committee in place first before we start contributing…"

"…this borehole does not serve the purpose, we continue drinking from the unprotected sources…"

"…eeeish queuing is my major problems, always we spend much time at the borehole and I don't think I can pay for that…"

From Box 10 above it is clear that opposition to operate and manage the BRWSS emerge due to increasing levels of poor service quality. The following constitutes poor service quality like 1) Unavailability of water, 2) Interrupted supply of water, 3) Inadequate quantities of water to meet demand, 4) Poor management and 5) Poor location of water supply system. These impact on the functionality and down time period of the borehole and increase levels of consumer dissatisfaction.

Analysing the reasons emerging from Boxes 9 and 10 above the researcher attribute consumer unwillingness to OMM to consumer dissatisfaction with the service due to similar reasons as for failing SLPIs presented in section 4.4.2 of this thesis.

Understanding Consumer Unwillingness from Consumer Satisfaction Lens

In order to understand the aspect of unwillingness of the consumer from the consumer satisfaction perspective the researcher tested the facts from box 10 above on a customer satisfaction perspective scale by analysing if the respondents/interviewees are comparing the perceived service with actual service. By way of comparison it is possible to substantiate the fact that unwillingness of the consumers emanates from dissatisfaction with the water supply.

Table 9: Analysing Consumer Unwillingness from Customer Satisfaction Lens

| Facts | Responses quotations from box 5 above | Does the fact compare Actual service with expected service |
|---|---|---|
| **Fact # 1** | "…we rarely have water from this borehole so why should we contribute..." | YES |
| **Fact # 2** | "…there is no water as you can see throughout summer time and as such we see no reasons to contribute…" | YES |
| **Fact #3** | "….I stopped contributing because I don't use water from this well for much of my domestics needs as it is very far…" | YES |
| **Fact #4** | "…we need a trusted management committee in place first before we start contributing…" | YES |
| **Fact #5** | "…this borehole does not serve the purpose, we continue drinking from the unprotected sources…" | YES |

In summary Table# 9 above shows that the primary root cause of unwillingness to OMM the borehole rural water supply facility is the increasing dissatisfaction state of the consumer attained after comparing the expected service quality with the actual service quality obtained from the BRWSS.

Unearthing Root Causes Of Consumer Disatisfaction

In section 4.4.2 above six factors were identified to be responsible for failing SLPIs that affect consumer motivation and satisfaction with a rural water supply system. These challenges are related to the pillars of the BRWSS as follows:

1. Quantity of available ground water (P1-Hydrogeological pillar)
2. Capacity to provide adequate water (P2-Design and Construction quality pillar)
3. Capacity to provide quality water (P3-Water Quality pillar)
4. Technical capacity to Operate Maintain and Manage (P4-Technical Capacity pillar)
5. Adequacy of financial resources (P5-Financial Capacity pillar)
6. Availability of Trained members of committee (P6-Management pillar)

These factors are refered to as pillars of a sustainable borehole rural water supply in the current research. The respondents were asked to identify structural pillars were affecting

sustainability of their borehole system rural water supply facility. Table 10 below indicates the pillars affecting sustainability on every case study:

Table 10: Failing Pillars that Affect Sustainability of the Research Case Studies

| | P1 | P2 | P3 | P4 | P5 | P6 |
|---|---|---|---|---|---|---|
| Case 1 | | | | | √ | |
| Case 2 | | | | | | √ |
| Case 3 | | √ | | | | |
| Case 4 | | √ | | | | |
| Case 5 | | | | √ | | |
| Case 6 | | | | √ | | |
| Case 7 | | | | | √ | √ |
| Case 8 | | | √ | | | |
| Case 9 | | | | | √ | |
| Case 10 | √ | | | | | |

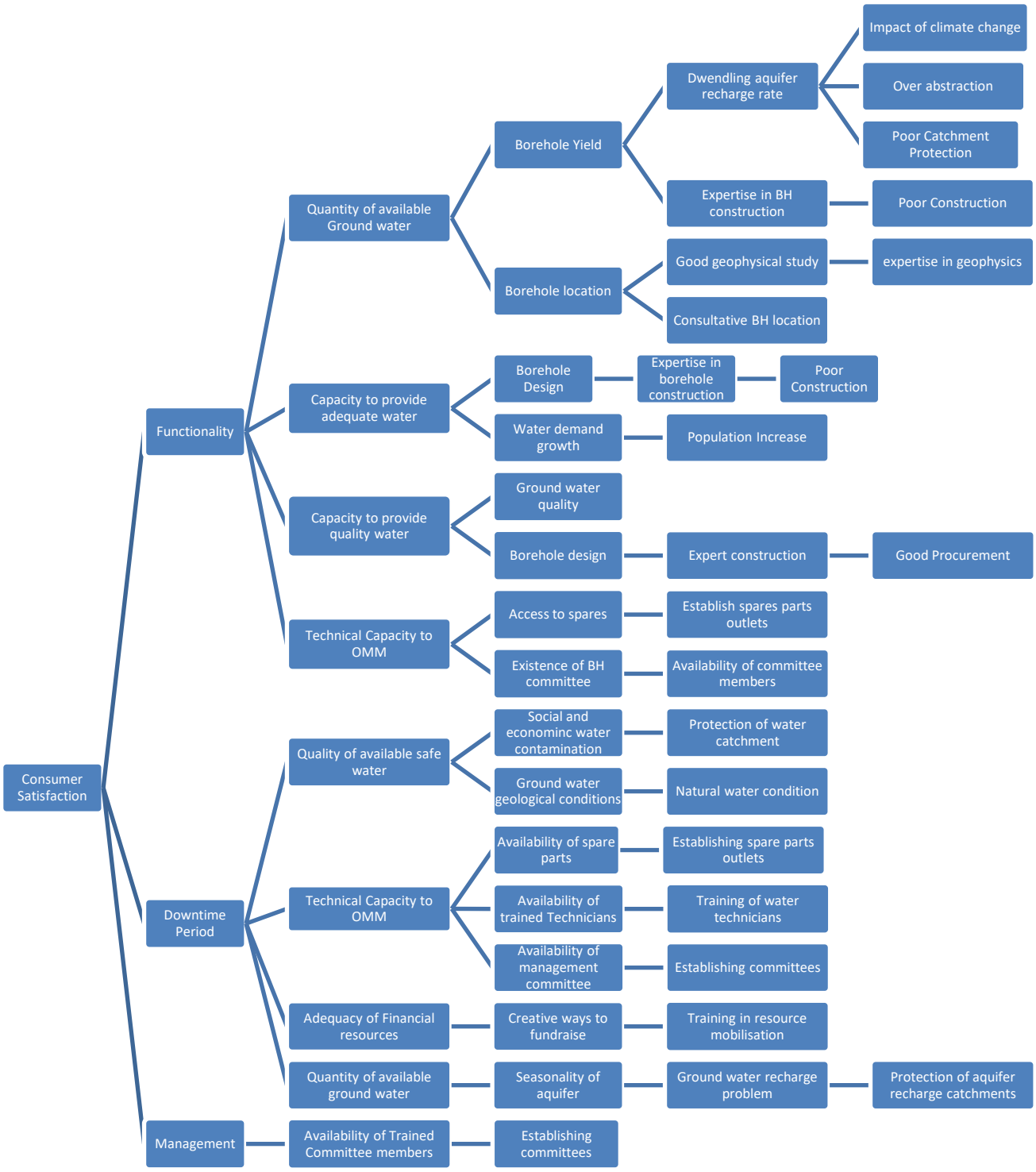
Table 10 shows that almost every case study has challenges a failing sustainability pillar. In order to manage consumer satisfaction for purposes of sustainability of rural water supply it is important to identify which sustainability pillars are failing, what are the problem root causes responsible for their failure and devise means of managing them as presented in section 4.7 of the current research.

## 4.7 Determinants of Consumer Dissatisfaction in Rural Water Supply

Just like what Ungwe (2015) did in the research for sustainability management for piped drinking water services did similarly the researcher analysed how the factors relate to determine triggers of consumer dissatisfaction in borehole rual water supply systems (see figure 12 above). In the section 4.7.1 to 4.7.6 of the thesis the researcher used a root cause analysis to identify problem root causes and developed strategies to combat the root challenges. The strategies are to assist in attaining a desired state (DS) of sustainability that is depicted by the six identified pillars. As found in section 4.6 there are six desired state that every borehole is expected to achieve or else the service level performance indicators will be compromised.

The Reality tree in figure 12 below explains how factors affect each other to impact on service level indicators that trigger consumer dissatisfaction.

Figure 12: The Reality Tree of Drinking Water Supply



Source: Author

### 4.7.1 The Hydrogeological Pillar of Borehole Rural Water Supply System

The hydrogeological pillar of rural water supply is about ensuring that there is adequate ground water available to meet demands of the consumer. The desired state is when available ground water is adequate to meet consumer demand. To attain this desired state of a borehole it means the strategy should ensure that boreholes are optimally installed where there is adequate ground water to meet the demand of the consumers around it. Box 11 below presents quotations on factors that affect quantity of available ground water.

Box 11: Factors Affecting Availability of Ground Water

"…the well fields abstract large quantities of water leaving nothing for the community…that is why consumers abuse the facility the idea is to draw the very remaining available water down there…"

"…with the changes in climate being experienced it is not amusing to see our boreholes drying up…"

"…it is not strange these contractors who come here to drill boreholes are their friends and are not picked on merit…"

"…we saw the methods used to locate water anyone can do that no wonder we didnt locate the best quantities and hence consumers forcing the borehole to produce water consequently breaking it…"

"…had it been that the community was consulted we could have found the best spot for the borehole this is our home…"

"…we believe that had it been that the contractor done a good job of drilling we could have been having enough water to service us better and these breakdowns could be avoided…"

From box 11 above there are a number of themes that emerge and justifies why a proper strategy should be put in place to ensure that the hydrogeological pillar is sustained.The following themes emerge 1) ground water abstraction rates 2) climate change 3) construction quality 4) geophysical surveys 5) community involvement

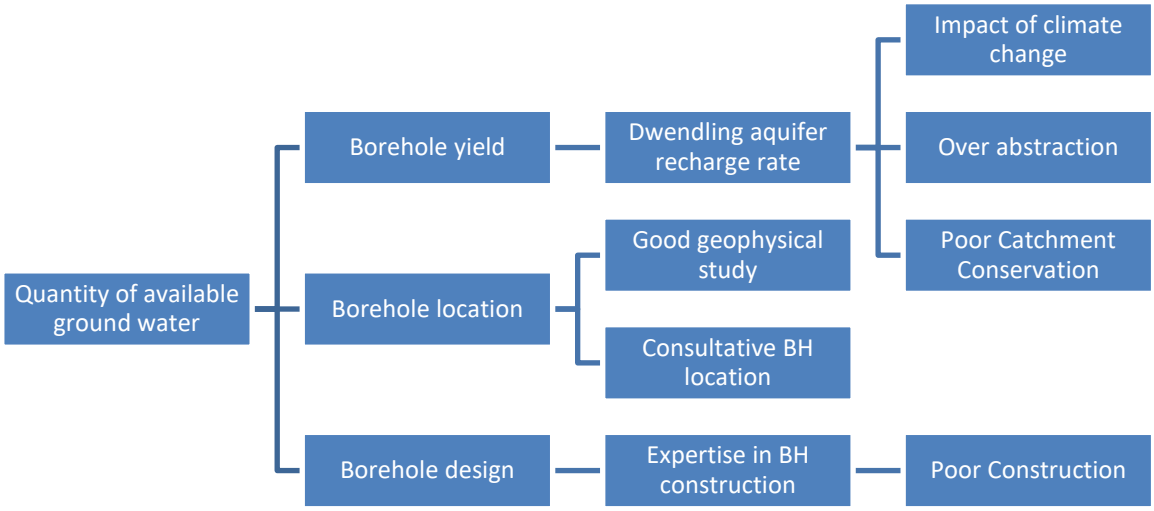
In some of the case studies conducted in the current research it was found that quantity of available ground water was inadequate. For instance in some of the research cases borehole yield was less than 0.25 liters per second. In some of those cases it was found that the factors that result in low quantities of ground water being available for the consumer were not managed.

Some factors that result in low ground water availability are technical and some are social. The technical factors relate to the sufficiency of the groundwater as stored in the aquifer serving that borehole and its population. The consequency of failing to manage the root causes of inadequate availability of ground water are over pumping per unit quantity of water drawn (e.g. more pumping strokes/20L bucket) and frustration of the consumer. Overpumping and frustration often leads to physical abuse of the water system which result in faster wearing out of the mechanical parts of the borehole and consequent frequent failures/breakdowns etc. In other words with less ground water available operation of the infrastructure is compromised.

Root Causes for Failing Hydrogeological Pillar of Borehole Rural Water Supply Systems

The research has found that there are six root causes of inadequate ground water; the root causes are an expansion of the factors presented in figure 12 above. The specific factors related to inadequate availability of ground water are presented in figure 13 below:

Figure 13: Root Causes of Inadequate Availability of Ground Water




In figure 13 above, poor construction has been added as an additional theme responsible for failing hydrogelological pillar of BRWSS. This means six root causes for inadequate availability of ground water have been identified as follows: 1) over abstraction 2) impact of climate change 3) Poor procurement procedures 4) Poor geophysical studies 5) Lack of consultative borehole location processes/community involvement 6) Poor construction.

Analysis of Root Causes that Affect the Hydrogeological Pillar

#### 4.7.1.1. Root Cause #1: Ground Water Over Abstraction (RC1)

One of the research cases that has low supply of ground water is close to wellfields (borehole installed for major ground water abstraction). These well fields have resulted in less water being available for the community boreholes surrounding them as a result of lowering water levels due to over abstraction.

Substantiating "over abstraction" as a root cause**:** Well fields are generally large diameter deep boreholes and water is drawn by heavy mechanical means often times powered by electricity. By drilling deep into the underground it means abstraction happens in multiple acquifers. Most common to the weathered zone aquifers is that recharge is seasonal often times relying on rainfall. So the more abstraction taking place from these aquifers the less ground water is available meet population demand.

If the well fields had not been drilled or if water was appropriately abstracted from the well fields then the borehole in this research case would be providing its consumer with adequate water. The boreholes surrounding the well fields were known to be providing its consumers with enough water before the well fields were constructed. When the daily rate

of water extraction exceeds the daily rate of aquifer recharge, then the borehole will eventually dry up (Harvey, 2004). Therefore failure to control or stop over abstraction is one of the reasons or root causes of less ground water being available for the community boreholes.

Lessons Learnt from Case Studies on Management of Over Abstraction.

Both consumers and water point committee members naratted the fact that no official from the Ministry of water approached them when well fields were being constructed and no one warned them of impact the well fields would have on existing boreholes near by. The communities said they will report to any NGOs who would come to work in their area to persue the matter. Relying on NGOs that do not exist is a non starter, as they may never come and communities will continue suffering/having no access to adequate water. To devise solutions for managing abstraction it is first important to understand why the community boreholes are not protected from over abstraction in well fields as follows:

1) There is no policy that regulates installation of wellfields
2) There is no mechanism that communities could use to stop or regulate large abstraction of water near their communities.

Proposed Solutions for Managing Ground Water Over Abstraction.

1. Instal Monitoring Wells to Provide Water Abstraction Data from Well Fields (S1)
   Installation of a monitoring well would assist the Ministry of Water in managing ground water abstraction in relation with the water demands of the surrounding community there by sustainably managing abstraction. When monitoring wells are installed it is possible to determine extent of impact on surrounding boreholes and minimise the impact.
2. Lobby for a Policy that Ensures Accountability on Water Rights (S2)
   The water rights are from a Malawi National Water Policy and its enforcement is under the National Water Resources Authority (Government of Malawi, 2013) that provides guidance on ground water abstraction. By enforcing that every abstraction is accompanied with water rights then situations like for this research case would not occur because any level of abstraction would automatically be noticed through monitoring boreholes and appropriate action taken immediately.

#### 4.7.1.2 Root Cause #2: Impact of Climate Change (RC2)

Problems currently being experienced regarding lowering rainfall quantities have an impact on presence of ground water (Christensen et al., 2007). This confirms respondents comments that with decreased rainfall they have started having challenges with quantity of

ground water available for consumers. According to the Malawi Meteorological Department data from 1960 to 2011 there is a general decrease in rainfall that ranges from 13.5% in areas like Mzuzu District to as worse as 34.4% in Chiradzulu (Ungwe, 2015). Almost in all the case studies decrease in rainfall amount has been experienced and impact on boreholes or water points has been experienced. This is no strange because Braune and Xu (2010) said that decrease in rainfall makes levels in dams and lakes to drop, river flows to decrease and ground water levels to drop.

During the time of the current research it was observed by the researcher that the boreholes that were once in an area surrounded by trees were now a lone/single infrastructure on bare land, the rivers that run around the boreholes were also dry and yet before they were perennial streams of water.

Substantiating "climate change impact" as a root cause is simple since with climate change it is clear that rainfall amount has decreased and consequently the dropping ground water levels. In fact Lockwood (2003) confirms the fact that quantity of ground water drops with low rainfall. Infact Harvey (2004) says rrainfall intensity during the month of drilling has a direct influence on failure rates meaning rainfall can falsely influence success rate of a borehole. Rainfall recharges the aquifers and hence increase the quantity of ground water available for consumption.

Lessons Learnt from Case Studies on Management of Climate Change.

Climate change impact can not be solved from a nucleus or can not be reversed in short term (Chen et al., 2010) as it is a global issue. In fact impacts of climate change we suffer today come from long periods of ruthless actions on mother nature. However despite the scale of the challenge the impact from climate change can be minimised by some actions.

Proposed Solutions for Minimising Impact of Climate Change

1) Turn the Water Catchment into a Protected Area (S3)

   Catchment protection conserves the little rainfall received from just washing away and getting wasted to getting infrated into the ground for ground water recharge. If catchments to boreholes could be identified and mapped then the area could be protected from careless farming methods that destroy land, growing of trees could be encouraged and monitored to control erosion and reduce run off. One case study in the current research had declared an water catchment protected. The community has grown trees and has asked the school near by to grow trees in the catchment and this has resulted in considerable improvement in ground water recharge and

now there is an improvement in availability of water from the borehole unlike in the past dry seasons when the boreholes in the area could completely dry up and fail to supply water.

#### 4.7.1.3 Root Cause #3: Poor Protection of the Catchment (RC3)

The researcher conducted interviews with several people in the affected case studies and found that where the water catchment is poorly maintained (for instance if heavy non conservative agriculture is practiced) then the capability of the catchment to hold water is lost as a result run off increases and less water infitrates the ground. The result is reduced aquifer recharge and consequent less ground water being available for the consumers.

Substantiating "poor protection of the catchment area" as a root cause: If there is less water infitrating into the ground or if the catchment is no longer capable of holding water then no water would be available for boreholes. Therefore poor protection of the water catchment is found to be one of the root causes for less ground water being available for the consumer.The catchments in these cases were found to be destroyed because of the following reasons:

1) People were carelessly cutting down trees in the catchment.
2) People were cultivating unconservatively in the catchment.

Proposed Solutions for Managing Water Catchments

1) Turn the Catchment into a Protected Area (S3) -The community can create by laws for the water catchment and completely stop people from cutting down trees in the catchment. Afforestarion activities could be carried out to cover the catchment with water holding trees.
2) Train Community on Conservative Agriculture (S4) – Soil conservative agriculture methods are known to protect the soil from being washed down to streams during rains and also help in holding water from run off. Government or Non Governmental Organisations can train people through agriculture extension workers and better farming methods can be taught.

#### 4.7.1.4 Root Cause#4: Poor Geophysical Survey (RC4)

Geophysical surveys are paramount for successful location and positioning of the borehole, geophysics help in determining presence of underground water. A variety of geophysical interpretation techniques is supposed to be used for identification of groundwater occurrence and identification of geological structures related to groundwater circulation. This process assists with selecting best sites for drilling boreholes. Specific geophysical

interpretation techniques depend on lithological mineralogical characters, alteration characteristics and structural setting of the survey areas.

The geophysical approach used for the hydrogeological investigations starts from the compilation of existing data and literature review if available as that assist in delineating various types of lithology, lineaments and relevant structures with special emphasis to hydrogeological properties. The methods deployed for underground water investigations are a basic part of the methodology. However these maybe complimented by other techniques depending on the geology and need as recommended by the field scientists.

Geological structures such as dykes, faults, lithology and shear zones having a control on the occurrence of groundwater can be deduced from magnetic field maps. The interpreted structures can then be targeted for further investigation by the electromagnetic and resistivity methods. A holistic geophysical approach is supposed to be applied in order to ensure that the objectives of borehole drilling project are met.

It was noted from the interviewees that drilling of boreholes was done without adequate supervision. The contractor opted for the best possible site in terms of access of their machines and not availability of water. It was also clear that contractors in some cases had a preference of positioning the borehole closer to some individuals for reasons not known however this was all at expense of the best spot for ground water availability.

Substantiating "Poor Geophysical surveys" as a root cause**:** If poor geophysical surveys are done then the best spot for underground water is missed resulting in insufficient availability of ground water which as seen result in increased demand pressure being exerted on the system to supply water which obviously result in frequent breakdowns.

When asked why contractors do not conduct thorough geophysical surveys before drilling a borehole, many contractors indicated that it is expensive and when they charge for full comprehensive geophysical studies they become expensive and not competetitive. Some contractors also highlighted that most times they conduct proper geophysical studies but the leadership in the community would persuade them to construct the borehole at a certain spot of preference of the community leadership.

Proposed Solutions of Ensuring that Contractors Conduct Thorough Geophysical Studies

a) Ensure adequate supervision is provided during geophysical survey and borehole construction period (S5) – Even though signs of presence of ground water can be there but it is important to note that rrainfall intensity during the month of drilling has a direct influence on failure rates (MacDonald & Davies, 2002). It is essential that

where drillers operate throughout the year, they develop compensation strategies for seasonal drilling. This is likely to involve drilling to greater depth in relation to dynamic water level during the wet season, but groundwater levels must be recorded in order to develop appropriate strategies for different geological environments. In terms of geophysics ensure that only reliable geophysics equipment is used and that only competent person are assigned to conduct geophysics and interpret results.

b) Ensure Adequate, Transparent Consultative Processes with the Entire Community Before Conducting Geophysical Surveys (S6) - Major causes of breakdown or non-sustainability of boreholes include boreholes constructed without adequate consultation with communities and lack of community involvement which lead to lack of ownership by communities, and so repairs and maintenance do not happen (Mays, 2007).

Comments from respondents during the survey confirmed that some local leaders influence choice of location for positioning of boreholes in the community. One woman commented *" …we just see the machines and the next day they are drilling next to village chief house and we have no say on that…"*. By influencing position of the borehole an opportunity is missed of locating the borehole at the best possible spot. Open, transparent and consultative processes in locating the area for the prospective borehole would take out influence that other community leaders have when locating the borehole.

#### 4.7.1.5 Root Cause #5: Lack of Consultative Borehole Location Processes (RC5)

Two cases that were found to have low yield were located near a local chief house. Comments from community members show that there were other better locations that could have better yields than near the chiefs house but the chief influenced positioning of the borehole.

Substantiating "lack of consultative borehole location processes" as a root cause: If the processes of locating the borehole was consultative and transparent then the borehole could have been located not only at a place convinient for everyone but also at a best spot location that taps into a good aquifer. Geophysical surveys are important for locating the best yeilding wells (Harvey, 2004).

Efforts at the time of the study to improve on consultations for locating a borehole were observed in one of the cases whereby the intervieews reported that for every development project the chief allows for an open discussion to take place deliberating on key things

regarding the project. Similary the chief allowed the community to discuss prefered location of the borehole project that was convinient to the community and the contractor was asked to conduct geophysical surveys in the same vicinity. The said borehole is known to be properly located and providing community with adequate water despite other sustainability challenges being faced.

It is also noted from intervieews that the affected boreholes could not follow a consultative borehole locating process because.

1) The service water providers do not want to conduct proper community mobilisation process because they are pressed with time.
2) The local leaders do not press for proper community mobilisation process because they have some selfish interest in where the borehole should be located

Proposed Solution for Ensuring that Adequate and Transparent Borehole Location Process is Done Before a Borehole is Drilled.

**1)** Ensure adequate supervision is provided during geophysical survey and borehole construction period (S5)

#### 4.7.1.6 Root Cause #6: Poor Construction (RC6)

When asked why poor construction is the cause for inadequate availability of ground water intervieews commented that as a community they are unable to know if the contractor assigned to drill in their community is a capable contractor or nor rather they rely on authorities to conduct proper background checks and verify capacity and expertise of the contractor. Some intervieews also commented that the only way to ensure proper construction is to have adequate and knowledgable supervisors who could efficiently supervise the works.

Substantiating "poor construction" as a root cause: Good construction includes proper citing/geophysical surveys, proper design and use of proper borehole construction techniques. When any of the above three key parametres of drilling wells are missed the potential of the borehole in providing adequate water for drinking is compromised (Malawi Government, 2008).

Efforts to avoid poor construction of boreholes is observed from other case studies and districts whereby before drilling of borehole is done, communities are trained on what to check when the contractor is drilling in fact the water point committee is established before drilling of a borehole is done. It was also observed in other areas that district water officer representative is always available during drilling to ensure that the contractors do not cheat.It is noted from the intervieews that the affected boreholes suffered from poor construction because:

1) The community was not trained before the drilling exercise and as such they could not provide oversight/supervision during drilling of borehole.
2) The district water officer was not involved in drilling of the borehole as such district level technical supervision was lacking

Photo 5: Children can even safely use a well-designed and constructed boreholes

<u>Proposed Solutions for Ensuring that Quality Borehole Construction Processes are Followed During Borehole Construction.</u>

1) <u>Ensure adequate supervision is provided during geophysical survey and borehole construction period (S5) -</u> Borehole failure increases with age and is most common at five years old or more. This means most borehole failures are associated with reduction in yields and degradation of well construction over time (Harvey, 2004). Therefore if construction adheres to standards and specifications then premature failure of boreholes can be avoided.

It is necessary to compensate for seasonal drilling to provide a realistic picture of borehole sustainability, pumping tests should ideally be undertaken at the peak of the dry season, when water levels are at their deepest (MacDonald et al., 2002). The initial measured yield of a borehole is the single largest factor that influences subsequent borehole failure. It is important that realistic guideline figures are set and adhered to. Boreholes with low yields should be drilled to greater depth with respect to dynamic water levels (and have longer screened intervals) than those with higher yields, rather than adopting a uniform approach.

2) Ensure community water point committee is established and predrilling training is adequately done before drilling of boreholes ( S7)

### 4.7.2 The Design and Construction Pillar of Borehole Rural Water Supply System

The second pillar of sustainability is the Design and Construction Quality Pillar. One of the desired state of the borehole rural water supply system is when the infrastrure is able to supply adequate drinking water. The strategy to attain this desired state is to ensure that the physical infrastructure is able to provide adequate water to the consumers surrounding it.

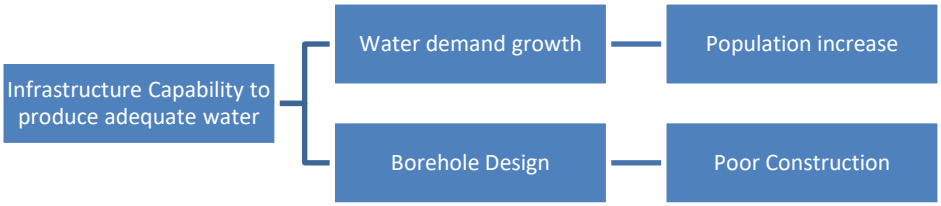
During the interviews it was noted that in some case studies the capacity of the boreholes to provide adequate water is deteriorating. When asked of the root causes of problems attributing to this undesired state of the water point respondents or intervieews mentioned of failure of the infrastructure/water system to produce water as a contributor to poor functionality. In some research cases it was observed that the borehole used to produce adequate water for the consumer but with passage of time the borehole failed to meet the consumer demand as a result the water points machinery/infrastructure were exteremly pressured/forced to produce more water and the system infastructure was physically overwhelmed leading to frequent breakdowns. The  factors thought to contribute to this are presented in box 12 below.

Box 12: Factors that affected capacity of the  borehole to provide adequate water

| |
|---|
| “Initially we were only few people using this borehole but now we are far more too many people using this borehole” |

"the borehole can no longer sustain all of us we needed a system that would pump a lot of water from the borehole and distribute to the community"

Figure 14: Reality tree of factors that affect capability of the infrastructure to produce water




From box 12 and figure 14 above the following themes emerge as problem root causes affecting Design and Construction Quality Pillar. These themes are found to be the root causes of functionality problems associated with capacity of the water system to produce adequate water for the consumer. The factors from these themes are 1) Increased Population and 2) Poor construction.

#### 4.7.2.1 Root Cause#1: Increased Population (RC7)

Lockwood (2003) and Wibowo & Mohamed (2010) agree on the fact that increased population lead to increase in water demand which exposes inadequacy of the design for provision of water supply system. Design of water supply systems is supposed to consider demand as a paramount design element to be considered always. When demand is considered during design stage then boreholes can be drilled with proper diametres that would allow installation of submersible pumps thereby allowing future upgrading of the water system. In Malawi, the physical water infrastructure are designed to provide for specific levels of demand in this case 250 people per borehole (Malawi Government, 2008). One interviewee commented that even though water comes from the borehole but still people que and there is always a long que line of people waiting for their turn leading to increased time spent in collecting water.This results in people unpatiently working the infrastructure system hard to provide water quickly which exterts a lot of physical/mechanical pressure on the system and frequent breakdowns.

Substantiating "increased population" as a root cause: With increased population there is increased water demand which is increasing pressure on the water system leading to frequent break downs of the system.The reasons why the water system could not satisfy the increased water demand are as follows:

1) The system was not upgraded into a community piped water system that would draw water even in the night and store it in storage tanks for use during the day.
2) New boreholes had not been drilled in the area ever since the existing borehole were drilled.

Proposed Solutions for Satisfying Increased Water Demand from Increased Population

1) Upgrade the High Yelding Boreholes into Community Piped Water Systems (S8) - By upgrading the water system to a small community piped water system mechanical pressure on the system is reduced and break downs are minimised.
2) Construct Alternative Water System (S9) - Borehole water systems are generally designed to take 250 people by constructing new water systems it means the existing water system will cater for a number of people it was designed for and other people will go to other water systems.

#### 4.7.2.2 Root Cause #2: Poor Construction (RC6)

Some interviewees reported that their borehole is sustainable because of the good workmanship/expertise of the contractor who drilled the borehole. In some other situations a borehole was certified 'successful' at the time of drilling but is now subsequently failing to deliver a sufficient yield of safe water throughout the year. Failure may be a result of a reduction in yield; plugging of the formation around the well screen by fine particles; sand pumping due to siltation, incrustation or corrosion of casing and screens; and structural collapse of casing and screens, often as a result of corrosion due to low-pH (acidic) waters (Driscoll, 1995). Over abstraction of water from the aquifer, and the ingress of pollutants may also result in borehole failure. Boreholes which are ephemeral in nature due to seasonal fluctuations in yield and water level, are also classified as failures, since although water was available directly following drilling but it is not available on a continuous basis.

At some research case studies respondents attributed frequent breakdowns to poor workmanship by the contractor (meaning the contractor did not do thourough research in understanding parametres that would potentially lead to failure to supply the user with sufficient water. This confirms the fact that if the borehole is poorly designed and constructed especially on what acquifer to tap from; where to instal slotted pipes and what type of filter material to use then likelihood of that borehole providing less water than it should have supplied (even if ground water was adequate) is high. Failing to supply adequate water increases the demand pressure on the system which would lead to premature mechanical failure or frequent breakdowns.

Substantiating "poor procurement procedures as a root cause**;** if wrong procurement procedures are used then incapable contractors will be engaged who would not have the right expertise in executing the job of drilling the borehole. A capable contractor is supposed to have the required, qualified and experienced personnel to do the works.

When asked why qualified contractors are not engaged to construct boreholes many respondents reported that clients and service providers are involved in fraudlent acts when engaging a contractor and that washes away the objective of the project.

Proposed Solutions for Ensuring that Only Qualified Contractors are Hired for Construction of Boreholes

1) Apply Transparent Procurement Process that Involves All Interested Stakeholders (S10)

   When projects for construction of boreholes arise then a multi stakeholder procurement committee should be engaged to scrutinise and evaluate the bidders. This process would allow stakeholders of varying interests to participate in the process of engaging the contractor there by making the fraudlent activities difficult to carry out. This will also assist in hiring only the best capable and qualified contractors to work on projects of this nature.

2) Ensure Adequate Supervision is Available During Geophysical Survey and Borehole Construction Period (S5)

   The current challenges of the water infrastructure failing to supply adequate water are due to short cuts during drilling or when conducting geophysical surveys. Comments from interviewees during visits to the borehole sites show that at one of the sites despite drilling to the depth of 49 metres the contractor installed pipes only to a depth of 30m. Analysing what might have happened show that very likely the contractor encountred collapsing soils as such delay in installation of casings resulted in loss of the other 19 metres of depth. However the contractors continued installing the pipes by taking advantage of communities lack of knowledge on the issue at hand. If supervision could be enhanced likelihood of losing boreholes like that could not have happened and the contractor could have have instructed to construct another borehole.

### 4.7.3 The Water Quality Pillar of a Borehole Rural Water Supply System

The water quality pillar is about the capacity of the water infrastructure to supply good quality water and the strategy is to ensure that water supplied from the water system is of acceptable quality. During the interviews in the case studies it was clear that there are

specific factors that affect quality of water produced by a borehole or in other words factors that affect the Water Quality Pillar as presented in box 13 below:

Box 13: Factors Affecting Quality of Production Water from Boreholes

"…the water from this well is saline infact the contractor was told that in this area we don't drill very deep boreholes because we end up tapping water with high salinity…".

"…it is strange that the water from this well look turbid or dirty, of course we were told that the contractor didn't use proper filter material for this borehole…"

"sometimes the water smells…may be its because we have toilets around that contaminate the water no wonder some of our small children suffer from diarrhoea even though we have a borehole…"

The intervieews quotations in Box 13 above show that poor water quality is indeed is an attribute of a number of factors like:

1) Failure of the contractor to conduct a thorough review of history of boreholes drilled in the area.
2) Failure of the contractor to use proper filter material.
3) Failure of the community to follow water, sanitation and hygiene guidelines.

The results implies that the quality of water from the boreholes was contaminated by the contractors construction methods and communities disregard of the recommended distance of construction of latrines from the borehole. Failure to manage these cases resulted in production of poor quality water from the borehole. Failing to manage quality of water resulted in poor quality water being produced from the borehole in some of the case studies. Quality safe drinking water is supported by Lockwood (2003) as a prerequistite for sustainability and as in the current research is key for satisfaction of the consumer.

Capacity to produce quality safe drinking water is an attribute of many factors that need to be solved in order to achieve consumer satisfaction. The figure 15 below presents interactions of various factors that are related to production of quality water.

Figure 15: Relationship of Factors that Affect Production of Quality Safe Drinking Water


There are five factors that affect capacity of the borehole to supply safe quality drinking water for human consumption. However the key root causes are 1) inappropriate latrine and water point distance and 2) poor construction.

#### 4.7.3.1 Root Cause # 1: Inappropriate Latrine and Water Point Distance (RC8)

In 2 of the 10 cases studied in the current research, boreholes were reported producing smelly water and that cases of diarrhoea were not as different as from the past when they used to drink from the unprotected water sources. The boreholes are forced to produce poor quality or contaminated water because there is a source of contamination nearby and these are latrines that people construct without observing the 50 meters minimum recommended distance from the borehole (Malawi Government, 2008).

Substantiating "In appropriate latrine and water point distance" as a root cause: If the latrine and water point distance was at the recommended distance of 50m radius of the water point then no contamination could be observed. The reasons why communities construct latrines less than the recommended distance from the water point are:

1) Lack of sensitisation-the communities had not received any WASH interventions apart from construction of a borehole.
2) Weak/inactive water point committee-the water point committee (WPC) had been inactive for sometime since other members of the WPC left

Proposed Solutions for Ensuring that Latrine and Water Point Distance is Observed

1) Conduct community WASH projects (S11) – community WASH programs like Open Defecation Free (ODF) campaigns and Sanitation and Hygiene sensitisation campaigns/projects need to be rolled out in the communities affected in order to inform the community of dangers of poor sanitation, poor hygiene in their communities and in the process address the issues of latrine and water point distance.

2) Monitor trend of feacal contamination (S12) – Considering the recent trends observed by community on increased prevalence of diarrhoe diseases it is important that both biological and chemical tests be conducted to ensure that water is not contaminated and is safe for human consumption.

#### 4.7.3.2 Root Cause # 2: Poor Construction (RC6)

When probed why poor construction is the cause for prodution of unsafe drinking water, interviewes commented that the short cuts adopted by some borehole drilling contractors are the cause because ever since the borehole was constructed no clean water had been drawn from the source. It is important to note that nothing happen despite numerous reports to the district authorities. As a community they dont know if the contractor assigned to drill in their area is a capable contractor. They rely on authorities to conduct proper background checks and verify capacity and expertise of the contractor. Some interviewes also commented that the only way to ensure proper construction is to have adequate and skilled supervisors who could efficiently supervise the works.

Substantiating "poor construction" as a root cause for poor quality water-Good construction entails proper citing/geophysical surveys, proper design, use of proper borehole construction techniques and use of quality recommended materials. When poor fliter material is used the likelihood of clogging is high similarly the likelihood of producing turbid water is high too (Carter, 2004).

Efforts to avoid poor construction of boreholes is observed from other sites and districts whereby before drilling of borehole is done communities are trained on what to check during borehole construction in fact the water point committee is established before drilling of a borehole is done. It was also observed in other areas that district water officer representative is always available during drilling to ensure that the contractors do their job with outmost care and quality for instance turbid water can also be a result of poor well development techniques. It is noted from the interviewes that the affected boreholes suffered from poor construction because:

1) The community was not trained before the drilling exercise and as such they could not provide their oversight/supervision role during drilling of borehole.

2) The district water officer was not involved in drilling of the borehole as such district level technical supervision was lacking.

Proposed Solutions for Ensuring that Quality Borehole Construction Processes are Adhered to During Borehole Contruction.

1) Ensure adequate supervision is provided during geophysical survey and borehole contruction period (S5)
2) Ensure community water point committee is established and predrilling training is adequately done before drilling of boreholes ( S7)

### 4.7.4 The Technical Capacity Pillar of a Borehole Rural Water Supply System

Functionality of the water point/borehole was observed to be affected by various factors as mentioned in box 14 below as observed in several case studies. These are the factors that affect the Technical Capacity Pillar of borehole sustainability. The desired state is to have a water ppoint committee that has adequate techncial capacity to operate, maintain and manage the borehole. The strategy to manage this pillar is by ensuring that technical capacity of water point committee is enhanced. This strategy is supported by Carter (2004) who states that for rural water supply services to be sustainable then water point committees should be trained, skilled and committeed.

Box 14: Factors that Affect Capacity to Operate, Maintain and Manage the Borehole

"…we cant maintain this borehole as required because some time to get the spare parts we need to travel  a distance more than the cost of the spare part itself…"

"…the challenge sometimes is the spare parts…we can raise the money but we cant get the spare parts…"

"…sometimes the committee waits until the system breaks down, they needed to do preventive maintanance…"

"…the people who were trained in borehole management are all gone, some moved from this village and some died, the current members were just incoperated into the system to fill the numbers, they have never been trained…"

"…this is all voluntary works and we don't get paid we sometimes spend our money when the borehole fund has no money…"

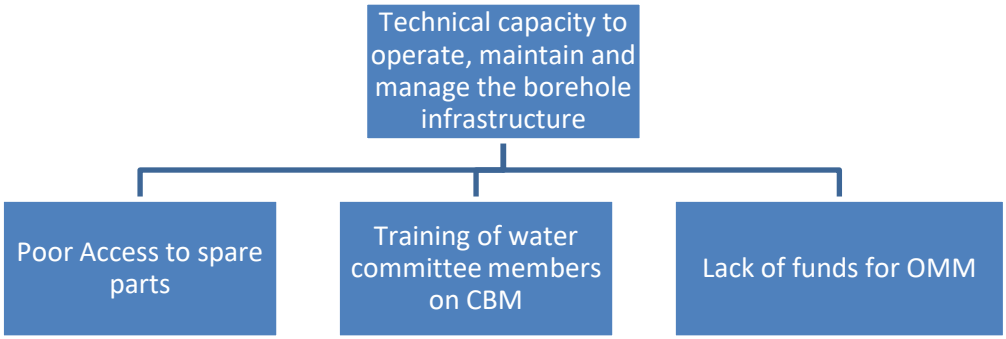
"…financing is key, the community members need to contribute for maintenance of this borehole but the borehole fund now has no money…"

The intervieews comments in box 14 above show that operation, maintenance and management of a water point is affected by many factors as follows:

1) Spare parts are not available within the vicinity
2) Committee has no skills to conduct preventive maintenance
3) New water point committee members were not trained for community based management of boreholes
4) Boreholes did not have enough funds for operation, maintenance and management of the borehole.

These above factors can be presented in a Reality Tree as in figure 16 below showing how the factors interelate.

Figure 16: Factors Affecting Technical Capacity Pillar of Sustainability.




During the data collection time it was found that factors that affect technical capacity of water point committees in managing their boreholes were not managed and as a result water point committee capacity was compromised and borehole functionality was affected. The desired state can therefore be achieved if the problem root causes are addressed.

The current research has found three root causes for insufficient capacity of the water point committee to conduct OMM as follows: 1) Poor access to spare parts; 2) Lack of WPCs training to conduct OMM; 3) Lack of funds to conduct OMM . Figure 16 above presents the relationship of the factors that affect OMM and the factors are explained below:

#### 4.7.4.1 Root Cause #1: Poor Access to Spare Parts (RC9)

Poor access to spare parts was noted during focus group discussions to be one of the reasons of committees failure to conduct OMM. Harvey (2008) support the finding that access to spare parts is critical for sustainability of rural water supply.

Substantiating “lack of access to spare parts” as a root cause - if spare parts were readily available in the vicinity then water point committees could have succeded in fixing the problem. Poor maintenance schedules and the absence of a robust supply chain for borehole spare parts negatively impacts boreholes maintenance and repairs (Fisher, 2011; Fosenka, 2008; Harvey and Reed, 2007).

In the current research spare parts were not available because government has not establshed a realiable spare parts supply chain that would enable easy access of spare parts for borehole equipment like Afridev pumps.

Proposed Solutions for Improving Access to Spare Parts.

1) Establish spare parts supply chains at district level (S13) – Readily available/accessible spare parts supply chains are known to reduce down time period of a water system (Montgomery et al., 2009). Government and service providers like NGOs should ensure that where boreholes are drilled a reliable proper spare parts supply chain exisit. Training of locals in manufacturing of spare parts is good as long as quality and production is well regulated by policy at all levels.
   Furthermore, Fisher (2011) has indicated that in order to sustain boreholes repairs and maintenance, there is need for the policy framework from Government outlining its support for rural communities. This should be in the form of the Government’s long term funds mobilization strategy, as well as a policy guideline standardizing the hand pump technology. For instance, in the current research, 83.0% of respondents indicated that the standardization of hand pumps (use of the Afridev) has enabled Pump Maintenance Technicians (PMTs) master the repair and maintenance of the boreholes.
2) Create a fast wearing spare parts inventory (S14) – boreholes committee members should ensure that always there is stock of fast wearing parts of the borehole at community level, this will ensure that at times of breakdowns atleast the water point committee has spare parts readily available to fix the problems. Fisher (2011) further indicates that borehole toolkits and spare parts should be located within local hardware stores within communities or available at the nearest market centre or town to enhance access.

#### 4.7.4.2 Root Cause #2: Lack of Training for Water Point Committees to Conduct Efficient OMM (RC10)-

Training is paramount to enable the water point committee execute their job professionally. When not trained it is difficult to understand what it takes to prevent frequent breakdowns or lengthy down time periods.

Substantiating lack of training for the water point committtee as a root cause – If the committee were trained on operation, maintenance and management of their water point then preventive maintenance could have been adequately done and serious breakdowns could have been avoided. In the current research it was observed that refresher trainings could not be done because they are not part of the implementation plans of the Ministry of Water or District assembly.

Proposed Solutions for Ensuring that Water Point Committees are Adequately Trained for OMM

1) Districts should initiate regular training courses for water point committtees (S15) – Regular training sessions by the district will help in providing a window for training new members as well as refresher trainings that could be given to already trained water point committees.
2) Develop community water point trainer of trainers (S16) – These community trainer of trainers would help in training new members of the water point committee who are selected to fill in gaps left by members who no longer work with the committees. Sufficient capacity at community level such as hand pump technical skills acquisition and the availability of trained Pump Maintenance Technicians in a community is also absolutely essential. Trainer of trainers could also cover up on locations where Water Point Committees, Pump Maintenance Technicians and other interest groups have all lost interest in sustaining the boreholes; and, where trained Pump Maintenance Technicians (mostly volunteers) at community-level have migrated away from the community and a new generation has not been trained.

#### 4.7.4.3 Root Cause #3: Inadequate Funding for Borehole OMM (RC11)

The other factor found to affect OMM is inadequate funding for borehole OMM. Funding is supported by Carter (2008) to be the most critical thing for sustainability of rural water supply.

Substantiating "inadequate funding for borehole OMM" as a root cause - if there is no funding for conducting OMM then borehole maintenance will be compromised and subsequently the lengthy down time periods and frequent breakdowns will be experienced.

Many consumers can not afford to raise the required monthly contributions that could help with complex maintenance activities or rehabilitation. Boreholes need rehabilitation or major maintenance works after ten years or so of operation and to do that subtantial amount of resources are required to hire a compressor to air blow the water hole and sometimes to replace the infrastructure.

Proposed Solutions for Increasing Funding for Borehole OMM.

1) Initiate creative ways of fundraising (S17) – by initiating creating ways of fundraising like the village savings loans money is easily raised to support rehabilitation or major maintenance activities. However this start from sensitization, there is always the need to sensitize and educate communities about the need to raise funds to manage (maintain and repair) boreholes from their internally generated resources than to wait for hand-outs from donors or Government (Fosenka, 2008; Harvey and Reed, 2007).

### 4.7.5 The Financial Capacity Pillar of Borehole Rural Water Supply System

During the interviews it was found that in some case studies capacity of the water point management committees to raise funds for major maintenance or rehabilitation is poor.This affects the Financial Capacity Pillar for sustainability. In order to manage this pillar then the strategy is to improve capacity of the water point committee in mobilising enough resources for conducting dynamic operation, maintenance and management of their water point. This is to ensure that the desired state whereby the community has capability to raise adequate financial resources for its sustainability is achieved.

When asked of the root causes of communities failure to raise financial resources for the borehole the intervieews reported of poverty as a major cause. However when compared to other case studies it was found that the case studies that were performing well in terms of raising financial resources are no different from those that are not in terms of poverty levels. Factors contributing to lack of capacity to raise enough financial resources for borehole maintenance, operation and management are presented in box 16 below.

Box 15: Factors Contributing to Failing Financial Capacity Pillar of Sustainability

"…we have a borehole village savings loans group that help in raising resources for the borehole every one in this community is welcome to join otherwise they contribute separately…"

"…to rehabilitate a borehole we were told by the people from the district that we need to hire a compressor and this community can not manage to raise those funds…"

"…you know what…people in this community can afford to buy a cell phone, charge it every day at a cost, and buy airtime but they cant pay for water…"

"…if financing is not enough we take long to fix the problem because we cant use our personal money to fix these problems…"

In summary from box 15 above it is found that the main reason of failure to raise adequate financial resources for major maintenance and rehabilitation is lack of creative ways of fund raising.

#### 4.7.5.1 Root Cause #1: Lack of Creative Ways of Fundraising (RC12)

One major factor that affect committee capacity to raise enough financial resources for conducting dynamic operation and maintenance is lack of creative ways of fundraising. Montgomery et al., (2009) support the fact that access to adequate financial resources to sort out water point needs for maintenance, operation and management is critical for sustainability of rural water supply.

Substantiating "Lack of creative ways of fundraising" as a root cause - Without creative ways of fund raising it is impossible to raise adequate financial resources for major maintenance works or rehabilitation of the borehole which are inevitable as the borehole design life passes with time. The reasons why there are no creative ways of fundraising are:

1) Water point committees do not know how to creatively raise financial resources for the borehole apart from mandatory monthly household contribution.
2) Water is not marketed as a product with a price attached and as such communities think water is priceless

Proposed Solutions for Ensuring that Communities are Engaged in Creative Ways of Raising Financial Resources for the Borehole.

1) Initiate borehole village saving loans with the borehole as a registered member (T18)
   This is in relation to the expectation that communities will always be in readiness to contribute human resources for capacity building and the financial resources required to effectively maintain and repair boreholes when they cease functioning (African Development Bank, 2011; Burgin and Rydbeck, 2010; World Vision Ghana, 1996, 2003).

### 4.7.6 The Management Pillar of Borehole Rural Water Supply System

From the intervieews conducted in the case studies it was clear that when the water point has no management in place then everything is done sporadically and consumers are dissatisfied as survival of their water system is in jeopardy. The desired state is when the water point has an active water point management team. The strategy to achieve this

desired state is to ensure that that borehole/water points have an active and skilled water point management committee always.

#### 4.7.6.1 Root Cause #1: Absence of Trained Water Point Committee (RC13)

Presence of a water point committee is paramount for sustainability of a borehole. Comparative analysis estimates indicate that as at 2006, 60.2% of hand pumps fixed on boreholes in Nigeria were non-functioning. The main reason for these hand pump failures was lack of maintenance of the hand pumps after installation. So with continued usage, serious wear and tear occurred until they finally ceased functioning (Eduvie, 2006).

Substantiating absence of a trained water point committtee as a root cause– If the committee does not exist then there is no one to take care of the operational, maintenance and management needs of the borehole and the borehole will eventually be destroyed or damaged. The main reason attributed to the poor functionality and low sustainability levels of borehole hand pumps is the lack of sufficient attention to borehole operation and maintenance by the beneficiary communities, as well as by the service providers – Government and donors (Harvey and Reed, 2004; MacDonald, 2005) however in order to provide effective and sufficient attention to OMM then people need to have enough knowledge through trainings. It was observed in the current research that when a trained water committee member leaves the area then there are no plans to train new committee members on OMM.

Proposed Solutions for Ensuring Presence of a Trained Water Point Committees Always

1) Districts should initiate regular training courses for water point committtees (S15) – Regular training sessions by the district will help in providing a window for new training as well as refresher trainings that are expected of water point committees.
2) Develop community water point trainer of trainers (S16) – These community trainer of trainers would help in training new members of the water point committee who are selected to fill in gaps left by members who no longer work with committee.

## 4.8 The Six Strategies for Sustaining Rural Water Supply Sustainability Pillars

The discussions in this chapter already alluded to the fact that there are three immediate results of failing to manage issues that affect sustainability of borehole water points and these are:

1. Immediate Result (IR1) Compromised functionality
2. Immediate Result (IR2) Lengthy down time periods

3. Immediate Result (IR3) compromised borehole management

These three immediate results of failing to manage problem root causes in rural water supply affect consumer satisfaction which is the end result (ER); the outcome being negative behavior that affect sustainability of boreholes in rural water supply in Malawi. The three IRs are a result of the intermediate problems (IPs) listed below:

1. Inadequate quantity of available ground water (IP1)
2. Inadequate capacity of the borehole to supply adequate water to the consumer (IP2)
3. Inadequate capacity of the borehole to supply quality water (IP3)
4. Insufficient technical capacity of the water point management to conduct effective and efficient operation, maintenance and management of the borehole (IP4)
5. Inadequate availability of financial resources (IP5)
6. Absence of an active water point management committee (IP6).

The intermediate problems listed above (IP#1-6) affect the following equal and important structural pillars of sustainability of rural water supplies. No pillar is superior to the other however effort and investment to sustain each pillar varies. Removing any of the structural pillars below would lead to failing sustainability. The structural pillars of sustainability are listed below:

1. The Hydrogeological pillar-P1
2. The Design and Construction Quality pillar-P2
3. The Water Quality pillar-P3
4. The Technical Capacity pillar-P4
5. The Financial Capacity pillar-P5
6. The Management pillar-P6

In order to sustain the above structural pillars of borehole sustainability then the following desired states with their strategies and specific solutions are developed as presented below. It is important to note that all the strategies need to be implemented in order to achieve sustainability.

<u>The Desired State for the Hydrogeological Pillar: Available Ground Water is Adequate to Meet Consumer Demand</u>

***Strategy 1:*** *The strategy is to ensure that borehole are installed where there is adequate ground water to meet the demand of the consumers around it.The strategy is developed to manage the following root causes:*

1) Over abstraction from well fields (IRC1)
2) Impact of climate change (IRC2)
3) Poor Protection of the cathment (IRC3)
4) Poor Geophysical Surveys (IRC4)
5) Lack of consultative borehole location processes (IRC5)
6) Poor construction (IRC6)

The solutions for implementation of the strategy are as follows:

1) Instal a monitoring wells to provide water abstraction from well fields (S1)
2) Lobby for a policy that ensures accountability on water rights (S2)
3) Turn the water catchment into a protected area (S3)
4) Train community on conservative agriculture (S4)
5) Ensure adequate supervision is provided during geophysical survey and borehole construction period (S5)
6) Ensure adequate, transparent consultative processes with the entire community before conducting geophysical surveys (S6)
7) Ensure community water point committee is established and predrilling training is adequately done before drilling of boreholes ( S7)

<u>The Desired State for the Design and Construction Pillar: Capacity of the Borehole to Provide Adequate Drinking Water to the Consumer is Sufficient</u>

***Strategy 2:*** *The strategy is to ensure that the physical infrastructure is able to provide adequate water to the consumers. The strategy is developed to manage the following root causes:*

1) Increased population (IRC7)
2) Poor construction (IRC6)

The solutions for implementation of the strategy are:

1) Upgrade the high yielding borehole into community piped water system (S8).
2) Construct alternative water system (S9).
3) Apply transparent procurement process that involves all interested stakeholders (S10)

4) Ensure adequate supervision is provided during geophysical survey and borehole contruction period (S5)

The Desired State for the Water Quality Pillar: Quality of water supplied from the borehole is acceptable

***Strategy 3:*** *Ensuring that the water system/borehole has the capacity of producing safe quality drinking water at all times. The strategy is developed to manage the following root causes:*

1) Inappropriate Latrine and water point distance (IRC8)
2) Poor construction (IRC6)

The solutions for implementation of the strategy are:

1) Conduct community WASH projects (S11).
2) Monitor trend of feacal contamination (S12).
3) Ensure adequate supervision is provided during geophysical survey and borehole contruction period (S5)
4) Ensure community water point committee is established and predrilling training is adequately done before drilling of boreholes ( S7)

The Desired State for the Technical Capacity Pillar: Water Point Committee has Adequate Technical Capacity to Operate, Maintain and Manage the Borehole

***Strategy 4:*** *Ensuring that water point committees capacity to conduct OMM are enhanced. The strategy is developed to manage the following root causes:*

1) Poor access to spare parts (IRC9)
2) Lack of training of water point committee to conduct OMM (IRC10)
3) Inadequate funding for borehole OMM (IRC11)

The solutions for implementation of the strategy are:

1) Establish spare parts supply chains at district level (S13).
2) Create a fast wearing spare parts inventory (S14)
3) Districts should initiate regular training courses for water point committtees (S15)
4) Develop community based water point trainer of trainers (S16)
5) Initiate creative ways of fundraising (S17).

The Desired State for the Financial Capacity Pillar: Community has Capability to Raise Adequate Financial Resources for Sustainability of their Water Point

***Strategy 5:*** *The strategy is to improve capacity of the water point committee to mobilise enough resources for conducting dynamic operation, maintenance and management of their water point*. *The strategy is developed to manage the following root causes:*

1) Lack of creative ways of fundraising (IRC12)

The solutions for implementation of the strategy are:

1) Initiate borehole village saving loans with the borehole as a registered member (S18)

The Desired State for the Management Pillar: Water Point has an Active Water Point Managing Team.

***Strategy 6:*** *The strategy is to ensure that borehole/water points have an active and skilled water point management committee always. The strategy is developed to manage the following root causes:*

1) Absence of trained water point committee (IRC13)

The solutions for implementation of the strategy are:

1) Districts should initiate regular training courses for water point committtees (S15).
2) Develop community based water point trainer of trainers (S16).

In summary, rural water supply sustainability is supported by six structural sustainability pillars. Each pillar is essential for attainment of a specific desired state and there are six desired states. Failing of these pillars is caused by various problem root causes and it is management of these problem root causes by means of implementing the proposed solutions that is essential for attainment of a particular desired state. When all six desired states are attained then all the six structural pillars of sustainability are strong and the three immediate results that are measured by the SLPIs are improved. This makes the consumer satisfied and increases their likelihood to display behaviours essential for rural water supply sustainability.

## 4.9 Enabling Environment Factors for Rural Water Supply Sustainability

Understanding from the interviews and discussions held with individual respondents and focus group discussions it is clear that to sustain a borehole in rural communities it is imperative that an enabling environment exists that would ensure that all strategies and solutions are effeciciently and effectively implemented. An enabling environment consists of a set of factors that need to be ensured prior to strategy implimentation.

Box 16: Quotations on Factors Consituting an Enabling Environment for Implementation of Strategies

"…there should be a policy direction on catchment area protection, with that its easy to make our rules and laws back in the community…"

"…NGOs should not get tired of us…they should continue training us, some of these trainings need a lot of resources…"

"…we see people conducting village savings loans, we want to do that too but we need training which we cant afford…"

"…Our borehole has a lot of water we can even supply to people locating at far places only if we had funds to upgrade the system…"

"…if we had funds we could plant trees in this catchment…"

"…we do not have properly set,strategic and reliable spare parts supplies…"

From the quotations in Box 16 above a number of factors need to be ensured for effective implementation of the strategies as follows:

1) Supportive legislation/Policy direction (EEF1)
2) External support (EEF2)
3) Adequate financial resources (EEF3)
4) Reliable spare parts supply chain (EEF4)

There are many requirements that were identified by Bhandari and Grant (2007); Harvey (2011) and Ungwe (2015) as critical requirements in general for rural water supply but to be specific for boreholes then the four factors above constitute an enabling environment for implementation of strategies.

Figure 17: Relationship of the Enabling Environment Factors with Strategies and Solutions


Figure 17 presents how factors that constitute an enabling environment affect implementation of the strategies for managing structural pillars of rural water supply sustainability.

1. Supportive Legislation/Policy Direction

In order of priority, supportive legislation or policy direction is the most important enabling environment factor of all. Access to water is a universal and constitutionally guaranteed right. Providing adequate water supplies has always been at the core of public duty and responsibility to the population of Malawi. The institutional rationale for water supply services in Malawi arise from the following needs; a) to protect available sources of water; b) to ensure wider rural water supply coverage; c) to respond to and fit in wider initiatives and goals; d) as emmergency response to the water needs of the population; e) to regulate activities in the sector. Government therefore is paramount in ensuring that its citizens have access to water. Government has authority to make policies that regulate and ensure equity in provision of safe water to all. Policies on local manufacturing of equipment and spare parts could be introduced, similarly government can direct use on new strategies of managing sustainability like the current research findings.

2. External Support

External support is still necessary to sustain projects outcomes overtime, despite the heavy investment in building community capacity for system management (Lockwood, 2003). This means as rural water supply projects are rolled out it is important to consider post construction support in the planning process. The different types of support may be in form

of engineering assessments, hygiene and sanitation promotion, financial assistance and trainings. For instance in a study by Prokopy and Thornsten (2006) on rural water sustainability in ninety nine communities in Peru, the authors found that post construction support did not affect functioning of the water systems however it was found that communities that received more postconstruction support visits were more likely to pay their water bills regularly and were more likely to express satisfaction with their water supply services, as compared to those in communities with fewer visits. It is therefore imperative that some form of post construction support is provided for the initial months of operation after commissioning to allow for a smooth transitionining on post construction needs of a water system.

3. Adequate Financial Resources

Every activitity that needs to be done on a water point needs financial resources to be properly done. So even though financial resources are one of the problem root causes but it still constitutes an enabling environment for sustainability to take place. It is therefore important to ensure that always there are adequate financial resources to support actitivies being carried out on a water system. Financial institutions should be intergrated in rural water supply by flexing up some rules on collateral to allow communities take loans for water, sanitation and hygiene improvement in their communities.

4. Reliable Spare Parts Supply Chain

Local spare parts manufacturing has long been seen as a break through for sustainability, meaning if local communities could be trained in making spare parts then spare parts would readily be accessible by communities. Manual water pumps are also not a complex thing to manufacture such that if improvements could be made then locally manufactured pumps could then be made to pump from deep boreholes. In summary all avenues that could result in local manufacturing of pumps and spare parts should be encouraged, strengthened and supported for sustainability of rural water supplies.

The enabling environmental factors in figure 17 above are essential in implementation of the strategies that are summarised in table 11 below.Table 11 provides a summary of key findings of the current research in a single table of findings. The findings presented show the relationship between Pillars, Immediate Problems, Strategies, Root causes and Solutions.

Table 11 Relationship of Pillars, Immediate Problems, Strategies, Root causes and Solutions

| No | The Pillar for Sustainability | Immediate Problems | Strategy for Managing Immediate Problem | Root cause factors | Solutions | Enabling environment factors |
|---|---|---|---|---|---|---|
| 1 | The Hydrogeological Pillar | Inadequate quantity of available ground water | S1: Ensure that boreholes are installed where there is adequate water to meet demand | RC1 | S1,S2 | Enabling Environment Factors 1 to 4 |
| | | | | RC2 | S3 | |
| | | | | RC3 | S3, S4 | |
| | | | | RC4 | S5, S6 | |
| | | | | RC5 | S5 | |
| | | | | RC6 | S5,S7 | |
| 2 | The Design and Construction Pillar | Failure of the facility to provide adequate water | S2: ensure that the physical infrastructure is able to provide adequate water to the consumers | RC7 | S8,S9 | |
| | | | | RC6 | S5, S10 | |
| 3 | The Water Quality Pillar | Inadequate capacity of the borehole to supply quality water | S3: Ensuring that the water system/borehole has the capacity of producing safe quality drinking water at all times. | RC6 | S5,S7 | |
| | | | | RC8 | S11,S12 | |
| 4 | The Technical Capacity Pillar | Insufficient technical capacity of the water point management to conduct effective and efficient operation, maintenance and | S4: Ensuring that water point committees capacity to conduct OMM are enhanced | RC9 | S13,S14 | |
| | | | | RC10 | S15. S16 | |
| | | | | RC11 | S17 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | management of the borehole | | | | |
| 5 | The Financial Capacity Pillar | Inadequate availability of financial resources | S5: improve capacity of the water point committee to mobilise enough resources for conducting dynamic operation, maintenance and management of their water point. | RC12 | S18 | |
| 6 | The Management Pillar | Absence of active water point management committee | S6: ensure that borehole/water points have an active and skilled water point management committee always | RC13 | S15,S16 | |

Table 11 presents the thirteen problem root causes for failing sustainability pillars.The problem root causes are specific to a particular structural pillar and desired state. Every problem root cause has specific solutions that have been proposed after learning from other research cases that have successfully managed the root problem. In total the current research has identified eighteen solutions. By learning from existing research cases evidence based solutions that are reliable and practical are found. The process of packaging root problems with specific solutions has led to discovery of thirteen sustainability prescriptions for rural water supply. Sustainability. The sustainability prescriptions are a " Do It Yourself " prescriptions that a practitioner in rural water supply can pick and implement once a problem and desired state are identified.

## 4.9 Impact of Consumer Satisfaction and Dissatisfaction on Consumers' Behaviour

Research question # 4 intends to define consumer satisfaction impact path way to rural water supply sustainability. Analysis was done by cross tabulations and regression in three progression steps. The first stage of regression was to establish the factors that have an impact on the rural water supply service quality whose indicators are down time period, frequency of breakdowns and management system. The second regression was to regress and establish how the three water supply service quality indicators affect consumer

satisfaction at this stage cross tabulations were also run to analyse the extent of impact. The third step is to regress consumer satisfaction with consumer behaviour, this is intended to discover if any statistical significant causal relationship exist between the two variables.

Consumer behaviour in the current research means participating towards ensuring that effective community demand, increasing access to capital and cost recovery, dynamic operation and maintenance are in place always.

In the current research desired consumer behaviour to sustain a water supply is depicted by the following actions as adopted from Montgomery et al., (2009).

Achieving effective community demand involves the following behaviours:

- Improving communication between the service provider and the beneficiary community
- Conducting comprehensive demand assessments and understand local priorities
- Increasing community ability to articulate demand and assure their negotiating power among donors and providers.
- Leading in ensuring development of critical-thinking skills and independent decision-making abilities in community members
- Encouraging and Empowering fellow rural individuals to take a principal role in demand assessment and project planning.
- Becoming initial adopters and casting themselves as champions of change through personal networks.
- Stimulating more reluctant community members to take action.
- Engaging apathetic local government officials in order to increase access to human and financial resources.

Increasing access to capital and financial sustainability

- Utilizing creative methods of loaning, saving, and managing funds that could allow households and communities overcome financial hurdles in water and sanitation
- Increasing financial sustainability by providing equitable access to improvements in water
- Ensuring that there is adequate support to cover up the technical short falls or financial gaps is critical.

Establishing dynamic operation and maintenance practices

- Establishing long-term, dynamic operation and maintenance practices

- Developing the financial plan structure and content.
- Developing operation plan that describe standards of operation
- Capacity building through skill development training seminars
- Including the primary users of the water system in the decision-making process
- Achieving gender parity in decision making and

  Compensating for time spent on community water commensurate with tasks performed

Table 12: The Relationship between Consumer Satisfaction and Water Supply Break Down Frequency

| | | *Water supply break downs in the past 6 months* | | | | |
|---|---|---|---|---|---|---|
| | | *Never* | *1-10 times* | *11-20 times* | *> 20 times* | *Average Total* |
| *Level of satisfaction* | Very satisfied | 56.9% | 50.9% | 41.2% | 16.7% | 52.9% |
| | Satisfied | 18.6% | 22% | 17.6% | 16.7% | 20.1% |
| | Low satisfied | 5.3% | 12.7% | 5.9% | 50.0% | 9.4% |
| | Not satisfied | 17% | 13.3% | 35.3% | 16.6% | 16.1% |
| | Don't know | 2.2% | 1.1% | 0% | 0% | 1.6% |
| | | 100% | 100% | 100% | 100% | 100% |
| | | (188) | (173) | (17) | (6) | (384) |

*Pearson Chi-square= 25.124, p=0.014*

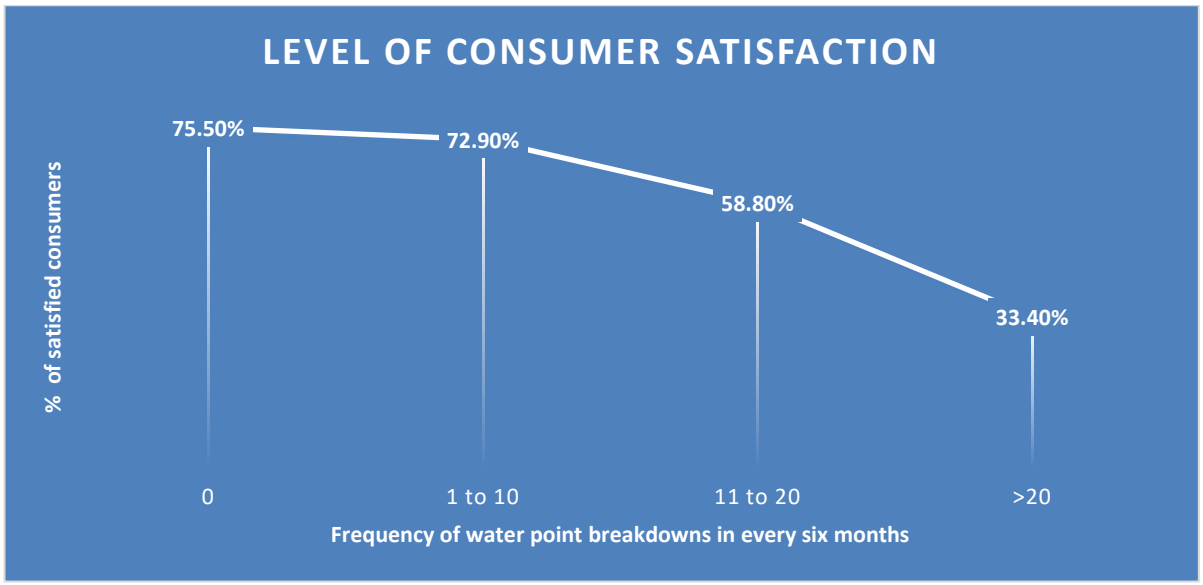
In table 12 respondents were asked to disclose their level of satisfaction and frequency of their water supply break downs in the past six months of the survey. This was to establish the relationship between functionality of the water supply facility and consumer satisfaction.

Observation

There are five categories of respondents in relation to their experience of break downs at their water point as follows 1) Never experienced a breakdown 2) Experienced 1-10 break

downs 3) experienced 11-20 breakdowns, 4) Experienced more than 20 break downs in the past six months of use of the facility.

Figure 18: Proportion of Satisfied Consumers in Relation to Frequency of Break downs




1) 75.5% *(sum of very satisfied and satisfied respondents)* of the respondents who never experienced a breakdown of the water facility were found to be satisfied with their water facility.
2) 72.9% *(sum of very satisfied and satisfied respondents)* of the respondents who experienced 1-10 break downs were found to be satisfied with the facility.
3) Just 58.8% *(sum of very satisfied and satisfied respondents)* of the respondents who experienced 11-20 breakdowns were found to be satisfied with their water facility.
4) Only 33.4% *(sum of very satisfied and satisfied respondents)* of the respondents who experienced more than 20 breakdowns were found to be satisfied with their water facility.

The relationship between the two variables in table 12 is statistically significant (*Pearson Chi-square= 25.124, p=0.014*) meaning water supply break down frequency or functionality has a statistically significant relationship with overall consumer satisfaction. However as per observation 1 and 2 of table 12, frequency of break downs should be managed to not exceed ten break downs in every six months of analysis in order to achieve at least two thirds of the consumers satisfied. Of interest in figure 18 and table 12 is the fact that even with no breakdown still there are other people who may not be satisfied with the water facility. This means that there are also other factors that contribute to overall satisfaction of the consumer other than frequency of break downs alone however a larger proportion of the consumer (75.5%) will use frequency of break downs as a measure of satisfaction.

Table 13: Relationship Between Satisfaction and Down Time Period of the Water Point

| | | *Water supply down time* | | | | |
|---|---|---|---|---|---|---|
| | | 1 - 48 hours | 2 - 14 days | 14 - 30 days | More than 1 month | Average total |
| *Level of satisfaction* | Very satisfied | 63.5% | 43.2% | 39.1% | 37.5% | 49.7% |
| | Satisfied | 13.5% | 32.4% | 21.7% | 12.5% | 21.5% |
| | Low satisfied | 10.8 | 12.2% | 26.1% | 12.5% | 13.3% |
| | Not satisfied | 12.2% | 12.2% | 13% | 37.5% | 15.4% |
| | Don't know | 0% | 0% | 0.01% | 0% | 0.1% |
| | | 100% | 100% | 100% | 100% | 100% |
| | | (74) | (74) | (23) | (24) | (195) |

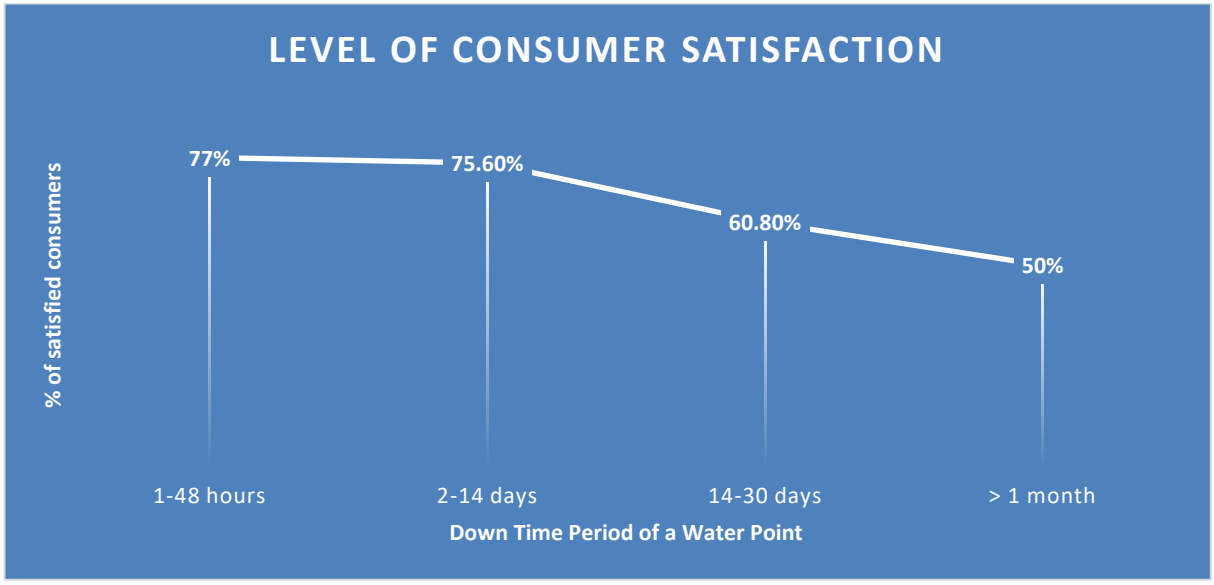
*Pearson Chi-square= 26.160, p=0.01*

In table 13 respondents were asked of a period that a break down takes to be fixed (down time period) and this was compared to their level of satisfaction. This was done to determine the relationship between down time period of the water point and consumer satisfaction.

Observations:

There are four categories of respondents in relation to their experience of water point down time period as follows 1) 1-48 hours, 2) 2-14 days, 3) 14-30 days, 4) more than a month.

Figure 19: Proportion of Satisfied Consumers in Relation to Down Time Period of the Water Point




1) 77% *(sum of very satisfied and satisfied respondents)* of the respondents whose experience of a down time lasted only 1-48 hours were found to be satisfied with their water facility.
2) 75.6% *(sum of very satisfied and satisfied respondents)* of the respondents whose experience of a down time lasted for 2-14 days were found to be satisfied with the facility.
3) Just 60.8% *(sum of very satisfied and satisfied respondents)* of the respondents whose experience of a down time lasted for 14-30 days were found to be satisfied with their water facility.

4) Only 50% *(sum of very satisfied and satisfied respondents)* of the respondents whose experience of a down time lasted more than 30 days or a month were found to be satisfied with their water facility.

The relationship between the two variables in table 13 is statistically significant (*Pearson Chi-square= 26.160, p=0.01*) meaning water supply down time period has a statistically significant relationship with overall consumer satisfaction. However as per observation 1 and 2 of table 17, down time period should be managed to not exceed fourteen days in order to achieve at least two thirds of the consumers satisfied.

The current research also cross tabulated consumer satisfaction with water point management model and it was found that the relationship between management model and satisfaction is not statistically significant with a Pearson Chi-Square value of 7.876 and a *p* value of 0.795. Meaning the management model is not an important element of consumer satisfaction.

Table 14: Multiple Regression Analysis of Consumer Satisfaction by Downtime Period, Frequency of Break Downs, Water point Governing Body and Management Model

| *Independent Variable* | *B* | $SE_b$ | *Beta* | *t* | *P* |
|---|---|---|---|---|---|
| Down Time Period | -.167 | .085 | -.144 | -1.956 | .05 |
| Frequency of Break Downs | -.311 | .198 | -.117 | -1.571 | .118 |
| Governing Body | .091 | .068 | .096 | 1.345 | .180 |
| Management Model | .157 | .096 | .115 | 1.627 | .105 |

*$R^2$=0.064, F (4,190) =3.271, p=0.013*

Table 14 presents the results of the Multiple Regression Analysis. The results show that at p<0.05 it is only Down Time Period (beta=-0.144, t (194) =-1.956, p=0.05) that plays a major role in predicting Consumer Satisfaction. Almost 6.4% of the variability in Consumer Satisfaction can be explained by reference to Down Time Period (Time taken to repair a water supply fault) $R^2$=0.064, F (4,190) =3.271, p=0.013.

Further analysis of consumer behaviour and consumer satisfaction show that the correlation and descriptive statistics for the regression of consumer behaviour on consumer satisfaction

is statistically significant with a Pearson Correlation of 0.253 and $p<0.001$; the correlation is positive meaning as consumer satisfaction increases so is consumer behaviour. The results too show that consumer satisfaction plays a major role in predicting consumer behaviour (beta=0.253, t (383) =5.119, $p<0.001$. Almost 6.4% of variability in consumer behaviour can be explained by reference to Consumer Satisfaction ($R^2$=0.064, F (1,382) =26.207, $p<0.001$). The logical presentation provides the below schematic presentation of how issues relate to each other in order to attain sustainability.

## 4.10 Summary

Chapter four discussed the specific procedures prior to and during the quantitative and qualitative analysis stage of the current research, and presented the research findings. Research question one attempted to identify the roles; question two and three focused on relationship and association whilst question four looked into prediction. Overall, thirteen problem root causes for failing sustainability pillars have been identified, eighteen solutions for managing the problems and six strategies to holistically solve the sustainability problems have been developed. Statistically significant relationships were identified and predictor variables were also identified for question five which is important for developing the framework.

Research question one was tackled qualitatively and it included analysing qualitative data collected from four focus group discussions. Thematic analysis of the data revealed the roles of the consumer and water point management teams; most important role of the consumer was revealed as being contribution of funds for operation, maintenance and management of the water supply facility. Research question two looked at the attributes of a water supply system and identified the structural sustainability pillars of rural water supply sustainability. These pillars are structural and none is redundant meaning it is important that all pillars are sustained otherwise sustainability will not be achieved. Research question three identified the factors responsible for failing sustainability pillars these are the root causes of sustainability failure. Strategies for managing the root causes were proposed and relationships of the factors were developed and packaged into thirteen sustainability prescriptions. The findings of research question number four has also concluded that consumer satisfaction in rural water supply is a statistically significant predictor of consumer behaviour as such consumer satisfaction should be a focus for rural water supply sustainability. This has revealed the essence of focusing on enhancing consumer satisfaction as a stimulant for desired consumer behaviours essential for rural water supply sustainability.

# CHAPTER 5: DISCUSSION AND FRAMEWORK DEVELOPMENT

## 5.1 Introduction and Overview

This chapter presents the current research discussions and conclusions on the final form of the proposed framework as indicated in the aim of the current research. It first presents the research questions as were set out in chapter 2, and then discusses the results in relation to the research questions and research objectives.

## 5.2 Research Questions

The framework of the current research is developed after addressing the following research questions:

(1) What could be the role of the consumer in rural water supply facility sustainability?
(2) What could be the pillars of a sustainable rural water supply
(3) What determines consumer dissatisfaction and satisfaction in rural water supply?
(4) How could the pillars of a sustainable rural water supply affect overall satisfaction of the consumer?
(5) What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?

## 5.3 The Roles of Consumer in Rural Water Supply

Research question #1 focused on determining the role of the consumer in rural water supply sustainability success. The reason for identifying the roles are to ensure that the consumers understand their responsibilities and roles. This research question dwells on identifying the roles of the consumer in rural water supply and this defines what is expected of the consumer in making the water supply sustainable. When the consumers and other stakeholders execute their roles honestly and willingly, it is a confirmation that there is adequate demand for the service and that sustainability will be attained (Carter, 2005). This is confirmed by the concept of demand as presented by Sara and Katz (1998), the concept of demand in water supply is defined by the quantity and quality of water that community members will choose to consume at a given price. Price as used here signifies all valued resources including an individual's time or labour given in exchange of a service.

In rural water supply the first major role of the consumer identified in the current research is providing financial resources for the management of the water supply facility (Baumann, 2005). On this point, the consumer financial responsibility role includes mandatory monthly financial contributions, once off financial requests, periodical financial contribution and

participation in other creative and innovative ways of fundraising (Montgomery et al., 2009). Mandatory monthly financial contributions ensure that resources are consistently available for operation and maintenance (Brikke & Bredero, 2003).

The second role of the consumer is operation/utilisation of the water system. The water supply system is made up of mechanical components that need to be carefully operated for maximum benefit as they were designed (Van Beers, 2001). The role of the consumer is to operate the water point facility with all care as possible. The main reason attributed to the low functioning rate and low sustainability level of borehole hand pumps is said to be the lack of sufficient attention to borehole operation and maintenance by the beneficiary communities, as well as by the service providers – Government and donors (Harvey and Reed, 2004; MacDonald, 2005). Water system operation is not commonly presented as a role of the consumer in literature however from the current research it is considered as a role of the consumer by the respondents (Uno, 2005). This creates an opportunity for streamlining water supply facility operational related expectations to the consumer.

In the current research respondents do not believe that it is a responsibility of the consumer to fix the water system when it breaks down, this means there is need to put in place adequate means of fixing water supply problems instead of looking for solutions from the consumer, once a water supply breaks down the water point committee should find means of fixing the problem. They need to analyse the problem and get it fixed quickly by themselves if the problem is minor or hire trained water supply technicians if the problem is major.

Overall, and with regard to research question one, findings showed that contributing financial resources for operation, maintenance and management of the water point is the first major ranked role of the consumer. The other role is careful or responsible operation of the water facility that would avoid premature mechanical failure of the water system. Executing various assignments pertaining to sustenance of the water supply as assigned by the water point committee is also another role of the consumer. This includes working for better sanitation and hygiene around the water point and contributing materials for construction of the water supply system or upgrading it and many more. These results are in agreement with Montgomery et al. (2009) who say that dynamic operation and maintenance, local financing and cost recovery, and effective community demand are a prerequisite for sustainability of rural water supply. Working for better sanitation and hygiene around the water point seem to be a new role emerging from the current research; this is not surprising considering integration efforts taking place globally on issues around water,

sanitation and hygiene, these integration efforts are encouraging water supply efforts to go together with proper sanitation and hygiene (UNICEF & WHO, 2008).

## 5.4 Supporting Pillars of a Sustainable Rural Water Supply.

Research question # 2 intended to identify pillars of a sustainable rural water supply. The research question # 2 was tackled in two phases; the first phase was from an analysis done in literature review which involved synthesizing literature and second was from focus group discussions where the following themes were identified:

1. Inadequate quantity of available ground water
2. Inadequate capacity of the borehole to supply adequate water to the consumer
3. Inadequate capacity of the borehole to supply quality water
4. Insufficient technical capacity of the water point management to conduct effective and efficient operation, maintenance and management of the borehole
5. Inadequate availability of financial resources
6. Absence of active water point management committee

From the themes above six support structural pillars of sustainability were identified and are:

1. The Hydrogeological pillar-P1
2. The Design and Construction Quality pillar-P2
3. The Water Quality pillar-P3
4. The Technical Capacity pillar-P4
5. The Financial Capacity pillar-P5
6. The Management pillar-P6

## 5.5 Determinants of Consumer Dissatisfaction

Research question #3 was to identify determinants of consumer dissatisfaction with rural water supply. The determinants of rural water supply dissatisfaction are the reasons of failing sustainability pillars. This research question therefore seeks to identify root causes of consumer dissatisfaction in a bid to find solutions for failing sustainability of rural water supply.

The root cause analysis has revealed a number of determinants of consumer dissatisfaction. This means management of these factors should curb consumer dissatisfaction and increase consumer satisfaction.

Research question #3 is the core of the current research as its findings helps in filling the gap that exists and thus low sustainability of rural water supplies emanating from unwillingness of the consumer to sustain the water system. By conducting a root cause analysis it was possible to identify the root problems and propose solutions and strategies of managing the support pillars. The root problem causes, solutions, strategies and enabling factors are presented in section 4.7 of chapter four.

The findings in the current research found that there are three immediate results (IRs):

1. Immediate Result (IR1) Compromised functionality
2. Immediate Result (IR2) Lengthy down time periods
3. Immediate Result (IR3) compromised borehole management

The findings in the current research found that there are six immediate problems (IPs) as listed below that affect sustainability pillars:

1. Inadequate quantity of available ground water (IP1)
2. Inadequate capacity of the borehole to supply adequate water to the consumer (IP2)
3. Inadequate capacity of the borehole to supply quality water (IP3)
4. Insufficient technical capacity of the water point management to conduct effective and efficient operation, maintenance and management of the borehole (IP4)
5. Inadequate availability of financial resources (IP5)
6. Absence of active water point management committee (IP6).

The findings in the current research developed six strategies for managing the immediate problems as below:

***Strategy 1:***

*The strategy is to ensure that borehole are installed where there is adequate ground water to meet the demand of the consumers around it.*

***Strategy 2:***

*The strategy is to ensure that the physical infrastructure is able to provide adequate water to the consumers.*

***Strategy 3:***

*Ensuring that the water system/borehole has the capacity of producing safe quality drinking water at all times.*

***Strategy 4:***

*Ensuring that water point committees capacity to conduct OMM are enhanced.*

***Strategy 5:***

*The strategy is to improve capacity of the water point committee to mobilise enough resources for conducting dynamic operation, maintenance and management of their water point*.

***Strategy 6:***

*The strategy is to ensure that borehole/water points have an active and skilled water point management committee always.*

Upon discussing the strategies the following immediate root causes (IRCs) have been identified in the current research:

1. Over abstraction in the vicinity (RC1)
2. Impact of climate change (RC2)
3. Poor protection of the catchment (RC3)
4. Poor Geophysical Survey (RC4)
5. Lack of consultative borehole location processes (RC5)
6. Poor construction (RC6)
7. Increased Population (RC7)
8. Inappropriate Latrine and water point distance (RC8)
9. Poor access to spare parts (RC9)
10. Lack of training for water point committees to conduct efficient OMM (RC10)
11. Inadequate funding for borehole OMM (RC11)
12. Lack of creative ways of fundraising (RC12)
13. Absence of trained water point committee (RC13)

In response to the immediate root causes of sustainability failure the current research has identified the following solutions to the problems:

1. Instal a monitoring well to provide data regarding water abstraction from the surrounding well fields (S1)

2. Lobby for a policy that ensures accountability on water rights (S2)
3. Turn the catchment into a Protected Catchment (S3)
4. Train community on conservative agriculture (S4)
5. Ensure adequate supervision is provided during geophysical survey and borehole contruction period (S5)
6. Ensure adequate, transparent consultative processes with the entire community before conducting geophysical surveys (S6)
7. Ensure community water point committee is established and predrilling training is adequately done before drilling of boreholes (S7)
8. Upgrade the high yielding borehole into a tap water system if the borehole has a good yield (S8)
9. Construct alternative water system (S9)
10. Apply Transparent Procurement Process that Involves All Interested Stakeholders (S10)
11. Conduct community WASH projects (S11)
12. Monitor trend of feacal contamination (S12)
13. Establish spare parts supply chains at district level (S13)
14. Create a fast wearing spare parts inventory (S14)
15. Districts should initiate regular training courses for water point committtees (S15)
16. Develop community water point trainer of trainers (S16)
17. Initiate creative ways of fundraising (S17)
18. Initiate borehole village saving loans with the borehole as a registered member (S18)

In addition to the strategies and root causes analysis findings, a detailed analysis of consumer's satisfaction show that consumer satisfaction is related to some specific levels of functionality. For instance it is found that customer satisfaction is lost when functionality exceeds 10 break downs in every six months (Bhandari & Grant, 2007). The relationship between functionality and consumer satisfaction is also found to be statistically significant (*Pearson Chi-square= 25.124, p=0.014*) meaning functionality has a statistically significant relationship with overall consumer satisfaction.

The results also revealed that there is a statistically significant relationship between down time period and consumer satisfaction (The Pearson Chi-square =26.160, and p=0.01 which is less than the critical p value of 0.05). It is also found that consumer's satisfaction can only be sustained for up to 14 days of waiting to get the water problem fixed otherwise exceeding that period dissatisfaction is triggered in the consumer.

## 5.6 Impact of Sustainability Pillars on Consumer Satisfaction.

Research question # 4 focused at determining the impact of sustainability pillars on overall consumer satisfaction. The six pillars presented in section 5.4 of the current research affect the three Service Level Performance Indicators that are critical for consumer satisfaction.

The structural pillars presented in section 5.4 are responsible for supporting/making rural water supply sustainable. None of these pillars is redundant as such each pillar needs to be managed to ensure that the six desired states for sustainability are attained. When all the six desired states are attained the three indicators used by the consumer to measure service quality will improve. The three service quality indicators are 1) frequency of breakdowns; 2) length of down time periods and 3) activeness of management system. When service quality improve then consumers satisfaction improves too there by triggering display of desired consumer behaviours that are essential for rural water supply sustainability.

## 5.7 Customer Satisfaction Based Framework for Rural Water Supply Sustainability.

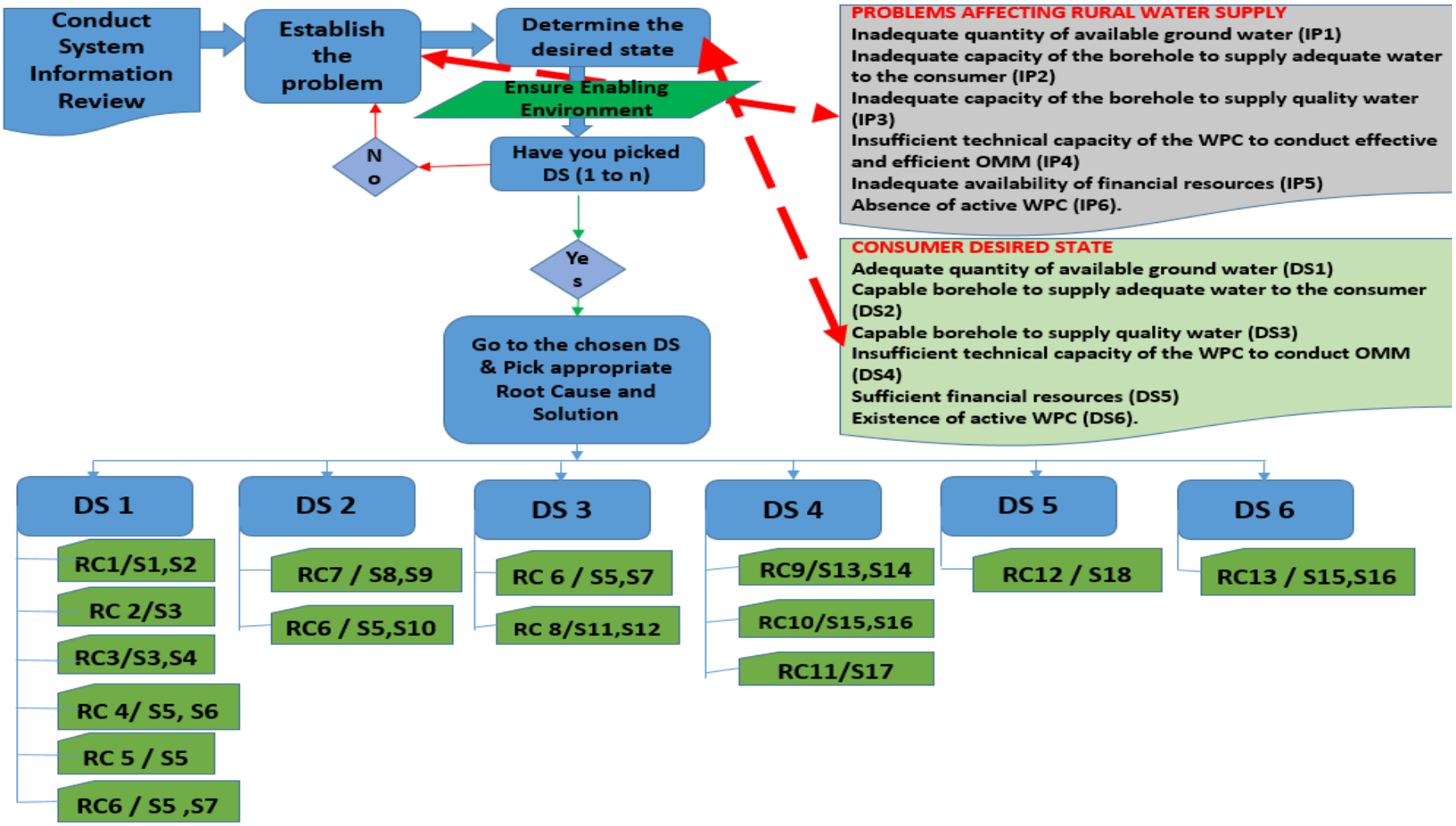
By means of root cause analysis a number of root problems were identified to be responsible for borehole rural water supply system sustainability failure. The current research also proposed the solutions and strategies for preventing sustainability failure. Literature review found that existing frameworks fail to address sustainability challenges or fail to enhance willingness of the consumer to sustain the water supply system (Montgomery et al., 2000). Indeed some frameworks address some issues and other frameworks address other issues (Ungwe, 2015) making the fight for rural water sustainability very complex. There is need for frameworks to be developed that could holistically address sustainability issues in rural water supply (Niyi and Felix, 2007) and the current research does exactly that by first identifying the root causes of sustainability pillar failures.

After analysing the pathway towards borehole rural water supply system sustainability the researcher has developed a logical framework that aims at enhancing consumer satisfaction thereby increasing the likelihood of the consumer in displaying the essential behaviours for borehole systems rural water supply sustainability as presented in figure 20 below.

The framework for sustainability in figure 20 below presents a series of actions that need to be done in order to ensure attainment of the six desired states of sustainability. The four step framework begins with the 1$^{st}$ step of conducting a system information review where data and all relevant information about the water system is collected and analysed ; 2$^{nd}$ step

is the diagnosis step, it is about identifying the problem, several who, what, where, when, why and how questions are asked to correctly identify the problems and relate them to the correct classified problems specified in the legend box; 3rd step is the determination of the desired state that the water system need to attain in order to make its users satisfied. It is important that at this stage all the four enabling environmental factors are ensured; 4th step is about choosing the right desired state and right prescription for managing the problem root causes. Sustainability is about ensuring that all the six desired states are attained and the three service level qualities are improved to enhance satisfaction and hence displaying the essential desired behaviours for sustainability.

Figure 20: Logical Framework for Sustainability of Rural Water Supply



In order to address issues of customer satisfaction in rural water supply it is clear from the findings chapter that the three service level performance indicators of functionality, downtime period and management should be achieved. However these result areas are affected by the pillars and the pillars are undermined by the immediate problems that have specific root causes that need to be addressed if customer satisfaction is to be achieved. Once the desired state are achieved then service level performance indicators are improved and this results in increased levels of consumer satisfaction which is an antecedent to positive consumer behaviour for sustenance of borehole rural water supply systems.

The consumer satisfaction based framework aims at increasing consumer satisfaction through the service level performance indicators and has four steps to follow as follows:

Step 1: Water System Information Review

Management of data of any water supply system is paramount (Ungwe, 2015). We are now in a situation where thousands of boreholes have been drilled in sub-Saharan Africa and little knowledge has been gained from them (MacDonald & Davies, 2002). The information we have must be used to its maximum potential, and further information should be collected and managed, in order to ensure sustainable development.

Borehole water supply systems are expected to have basic information or data like:

1. Depth of borehole
2. Static and dynamic water level.
3. Initial water quality results and subsequent water quality results
4. Borehole yield
5. Type of pump installed
6. Date of construction and subsequent years of rehabilitation
7. Population of the community
8. Committee information in terms of how many were trained, gender distribution etc.
9. Functionality in terms of the number of breakdowns in a particular period e.g. number of breakdowns in every six months
10. Downtime period in terms of time taken for a problem to be solved.

This information is important in determining trends and gaps in the system for decision making especially in step two when the real problem need to be identified.

Step 2: Identify the Problems (Diagnosis Stage)

Once the information is gathered an analysis need to be done to determine any flag up issues with the system. Using that information in stage 1 then a problem is identified. The following are the six common sustainability problems herein referred to as IPs faced in Malawi.

1. Inadequate quantity of available ground water
2. Inadequate capacity of the borehole to supply adequate water to the consumer
3. Inadequate capacity of the borehole to supply quality water
4. Insufficient technical capacity of the water point management to conduct effective and efficient operation, maintenance and management of the borehole
5. Inadequate availability of financial resources
6. Absence of active water point management committee .

When discussing the data or information gathered about the system it is possible to identify the problem being faced which will be one of the problems listed in step 2.

Step 3: Determine the Desired State (DS)

After establishing the problem being faced the next step is to determine the desired state which is generally the opposite of the problem being faced. Six desired states were developed as follows:

1. Adequate quantity of available ground water (DS1)
2. Capable borehole to supply adequate water to the consumer (DS2)
3. Capable borehole to supply quality water (DS3)
4. Insufficient technical capacity of the WPC to conduct OMM (DS4)
5. Sufficient financial resources (DS5)
6. Existence of active WPC (DS6).

The user of the framework may choose to look at one desired state at a time. When the desired state fails to match the problem being faced the process can be redone until the true desired state is determined. The framework is done in a way that multiple desired status can be determined so is multiple processes of step 4. This stage is very important as failing to establish the correct desired state may result in wrong prescription being used in step 4.

Step 4: Determining the Root Cause and Solutions

The framework has prescription to every root problem being faced. The current research has identified root causes of poor service performance of a borehole water supply system in Malawi. These root causes have specific solutions that are known to solve them and have been empirically determined in the current research. The current research has found thirteen root causes and eighteen solutions. The root causes and solutions have been packaged into thirteen prescriptions.

## 5.8 Enabling Environment Factors for Framework Implementation

The current research has identified four enabling environment factors for successful implementation of the framework as follows:

1) Supportive legislation/Policy direction (EEF1)
2) External support (EEF2)
3) Adequate financial resources (EEF3)
4) Reliable spare parts supply chain (EEF4)

The customer satisfaction based rural water supply sustainability framework is practical as it is developed from first principles in an empirical research study. The framework can be used before a project is initiated as this will help in developing robust project interventions that would mitigate occurrence of sustainability problems. The framework can also be used after the project was commissioned to remove problems that affect the water facility. The users or service providers need to create a system of collecting data, this data will be useful at step one of framework implementation. At this stage information is gathered and reviewed for use in step two when the problem is identified. Information can be gathered at every occurrence of a break down and also periodically every three months. To effectively manage sustainability then the four enabling environment factors need to be ensured always in order to achieve excellent results during implementation.

## 5.9 Summary

The discussion chapter approached its presentation from the research questions point of view, and all the five research objectives are met in the current research and presented in the discussion chapter.

Through research question #1; a number of roles of the consumer were identified. Understanding the roles of the consumer helps the researcher in developing a framework that would effectively address the issue of consumer behaviour in rural water supply.

Research question # 2 dwelled on identifying the pillars of a rural supply and establishing their relevance or statistical relationship to consumer satisfaction. Research question # 3 identified the determinants of consumer dissatisfaction and that is the whole reason of failing borehole rural water supply systems, in the current research a number issues that lead to satisfaction or dissatisfaction of the consumer were identified and are all related to level of service received from the water facility in terms of access, quality and quantity. The fourth question is on understanding the impact of consumer satisfaction on consumer behaviour. Detrimental consequences are found to come from consumer dissatisfaction and indeed good outcomes are found to come from consumers who are satisfied with the service and all these impacts are related to the roles of the consumer as presented in objective # 1. Research question # 5 is addressed in chapter 5 of the current research as it focuses at developing a framework that takes into consideration findings from the first four research questions of the current research. The consumer satisfaction based framework has been developed and the implementation process has been explained.

# CHAPTER 6: CONCLUSIONS

## 6.0 Introduction

The current research rationale is backed by calls from the United Nations that access to sanitation and safe water should be a basic right for everyone (WHO/UNICEF-JMP, 2012). To date some communities in Malawi still don't have access to safe water and worst still those that used to have access to safe water have gone back to unsafe sources because the water supply facilities have broken down and no one is there to repair them (see photo 2 and photo 3).

The current research has attempted to fill the research gap where a mixed methodological approach is used. The current research has developed an approach that can inform and shape design of rural water supply projects, central to the design is now consumer satisfaction with the rural water supply.

The researcher proposed a practical framework by suggesting the model that emanates from consumer satisfaction. It aims at minimizing trial and error approaches and provides a practical package that would enhance consumer satisfaction with rural water supply.

The first section aim at appraising the research questions and discussing the research objectives. The next section is about contribution to knowledge and recommendations including areas for future research.

## 6.1 The Consumer Satisfaction Based Model for Rural Water Supply Sustainability

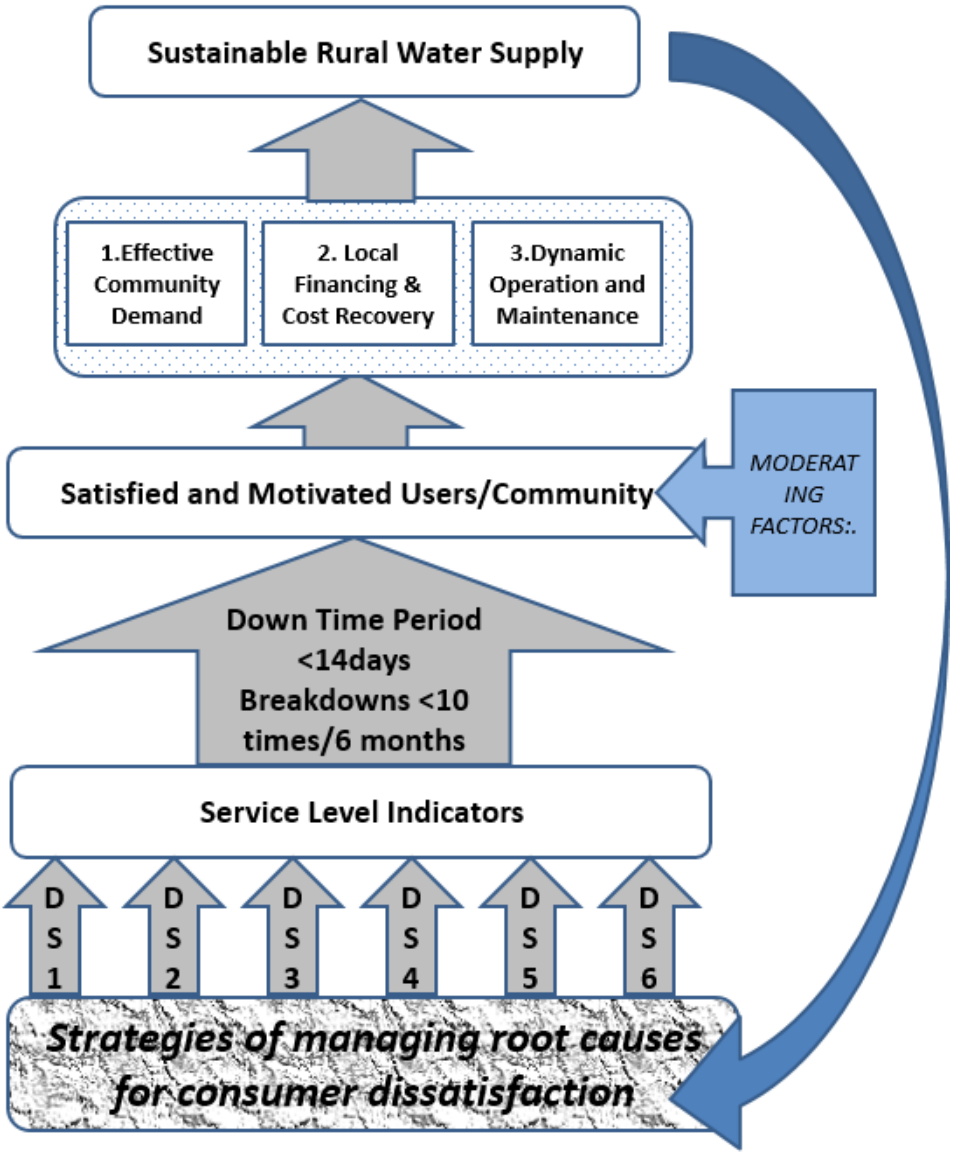
Groundwater provides potable water to an estimated 1.5 billion people worldwide daily (DFID, 2001) and has proved the most reliable resource for meeting rural water demand in sub-Saharan Africa (MacDonald & Davies, 2002). Boreholes equipped with hand pumps are a common technology adopted by poor rural communities, and there are currently approximately 250,000 hand pumps in Africa (HTN, 2003).

The model for sustainability of boreholes has been developed. In the model consumer satisfaction is now the focus for sustainability of rural water supply and by analysing qualitative and quantitative evidence related to rural water supply from chapter 4 and 5 sustainability prescriptions for managing rural water supply problems has been developed. The framework proposes focusing on root problem causes that are responsible for failing sustainability pillars. This will improve performance of the service level indicators thereby

improving consumer satisfaction. Improving consumer satisfaction will motivate the consumer to display behaviours essential for sustainability of rural water supply.

The current research questions reshaped the current research conceptual framework as was introduced in the beginning of the current research (see chapter 2). After answering the research questions and discussing the research findings the conceptual framework is revised, as some new relationships and concepts are identified, and the conceptual framework has taken its final form, which is presented in figure 21 below.

Figure 21: Consumer Satisfaction Based Model for Rural Water Supply Sustainability




Source:Author

The model is developed from figure 7 in chapter two of the current thesis. From the eight categories of factors that were known to affect sustainability in the conceptual framework in figure 7, the new model has the six desired states that are a result of management of root problem causes of failing sustainability pillars in figure 20 of chapter five. The conceptual framework in figure 7 has been enhanced by adding the satisfaction acceptable targets (SAT). These SAT levels are essential for attaining a two thirds majority of the community satisfied with the service quality. In order to achieve consumer satisfaction the framework has to achieve down time period SAT level of no more than fourteen days whilst the SAT level for frequency of breakdowns should be no more than ten break downs in every six months.

The new model brings to light a number of enabling environment factors and these factors are critical for effective implementation of the model. Figure 17 of the current thesis beginning with a supportive legislation/policy direction brings to light the critical role that government needs to play to ensure that strategies are well implemented and that sustainability is achieved. The other enabling environmental factors are external support, access to financial resources and reliable spare parts and equipment supply chain.

The model acknowledges that much as a satisfied consumer is a predictor for the desired behaviours essential for rural water sustainability as was presented by Montgomery et al., (2009), but the service level indicators of functionality, down time period and active management are important as they are the factors that are used to measure customer satisfaction in rural water supply. These service level indicators are dependent on stability of the sustainability pillars. The pillars stability is also dependent on management of the root problems. The framework is a handy tool for rural water supply service providers who struggle with the practicality of “sustainability” in rural water supply programming.

The rule of the thumb in ensuring that a consumer satisfaction focused rural water supply project is successful is to have three things in place as presented in section 5.7, figure 20 of the current research;

1) Firstly is to understand the problem, and the problem is easier to understand if data is available so in this case record keeping is important.
2) Secondly is to understand the desired state. This will involve asking the tough questions “who, what, where, when and how questions”
3) Third is to understand the impediments / root causes that result in failure to attain that desired state.

4) Forth is to ensure that all the enabling environmental factors are in place before rolling out any project

The customer satisfaction based model above is a final work as a result of accomplishment of the research objectives presented in section 6.2 below.

## 6.2 Accomplishments of Research Objectives

The current research has specific objectives and in this section the researcher explains how the research objectives have been achieved by way of appraising the research questions as presented below:

**Objective 1: To establish the Role of the Consumer in Rural Water Supply Sustainability Success**

This objective was achieved through the interviews and focus group discussions that were conducted on research question #1 *"What could be the role of the consumer in rural water supply facility sustainability?"* The idea is to come up with a comprehensive list of activities or responsibilities expected of a consumer. This helps in knowing what to observe as far as consumer behaviour is concerned and thereby assist in monitoring if the consumer is slagging on their responsibilities or not. Section 5.3 of this thesis presents an explanation of the comprehensive list of the roles of the consumer as follows 1) Providing financial resources for the management of the water supply facility; 2) Careful or responsible operation of the water facility that would avoid premature mechanical failure of the water system; 3) Executing various assignments pertaining to sustenance of the water supply system as assigned by the water point committee like working for better sanitation and hygiene around the water point and 4) Contributing materials for construction of the water supply system and even upgrading it.

**Objective 2: To Identify Pillars of a Sustainable Rural Water Supply;**

Critical review of literature revealed that a number of factors affect sustainability of a rural water supply. The research objective was achieved by answering research question #2 *"What could be the pillars of a sustainable rural water supply"*. It was found during interviews that the same factors that affect sustainability also affect consumer satisfaction and indeed willingness of the consumer to sustain the water supply facility. Six structural pillars were identified and are presented in section 5.4 of this thesis as follows 1) The Hydrogeological pillar; 2) The Design and Construction Quality pillar; 3) The Water Quality pillar; 4) The Technical Capacity pillar; 5) The Financial Capacity pillar; 6) The Management pillar.

Understanding these pillars is critical because they help in determining the root causes of their failure. All the ten case studies in the current research were found to be failing in one way or the other on the pillars and this was found to affect the consumers' level of satisfaction. Consumers' level of satisfaction was found to be varying with severity of damage done on the sustainability pillars.

**Objective 3: To Establish Factors Behind Rural Water Supply Consumers' Dissatisfaction or Satisfaction;**

The factors behind rural water consumer dissatisfaction and unsustainability are generally not the factors found in existing frameworks and approaches rather they are the root causes of the failing pillars of sustainability (see section 5.5 of chapter 5). Research question #3 is "*What determines consumer dissatisfaction and satisfaction in rural water supply?"* The determinants of consumer dissatisfaction are the problem root causes of failing service level performance indicators of a water supply system. Six strategies, thirteen root causes and eighteen solutions have been developed to manage the six immediate problems that lead to poor performing service quality level indicators or failure of the pillars. The root causes are found by means of a root cause analysis where interviews or participants of the focus group discussions reveal the facts behind the failing pillars.

**Objective 4: To Determine How the Factors behind Consumer Dissatisfaction could be managed for Sustainability of Rural Water Supply**

During the current research solutions were identified by understanding what is working in managing the problems in some case studies. These are the case studies that were performing well in managing similar problems. This research objective was managed by answering research question #5 *"How could the pillars of a sustainable rural water supply affect overall satisfaction of the consumer?"* This research question is about managing the factors behind consumer dissatisfaction. Eighteen empirical based solutions are proposed to manage the root causes of failing sustainability pillars. These pillars are responsible for consumer dissatisfaction. Thirteen sustainability prescriptions have been developed to manage rural water supply problems (see section 5.5 of chapter 5) and are presented in the current research as a *"Do It Yourself"* prescriptions that practitioners in the rural water supply industry could use to manage sustainability.

**Objective 5: To Develop a Framework for Enhancing Consumer Satisfaction with Rural Water Supply in Malawi**

The customer satisfaction based framework for sustainability of rural water supply has been developed by answering research question #5 *"What could be the best consumer satisfaction based framework for functional sustainability of rural water supply systems in Malawi?"* The framework helps us in dealing with the real root causes of the problems of sustainability. The framework is developed to enhance customer satisfaction as a stimulant for increasing willingness of the consumer to sustain the water supply system. Consumer willingness to support sustainability of the water supply system depends on the performance of the three service level indicators that the customer uses in evaluating performance of the water supply system. Based on the ten case studies it has been found in the current research that consumer willingness to support rural water supply sustainability is high when the consumer is satisfied with performance of the facility. By using this framework the three service level indicators of functionality, down time period and activeness of the management committee will be enhanced and customer satisfaction will increase, hence display of the desired positive consumer behaviour essential for sustaining the water supply system.

## 6.3 Contributions of the Research

The current research reflects an original contribution to knowledge in many respects, theoretical, methodological, and practical. First of all, it makes a number of contributions to the water sector more specifically rural water supply. The sustainability benefits that the rural water supply experience has long been addressed in rural water supply studies (Harvey & Reed, 2007). Similarly consumer satisfaction studies in the corporate world have provided evidence on impact of consumer satisfaction on repurchase, word of mouth etc. (LaBarbera and Mazursky 1983, Yi 1990) but both studies have not been studied in a unified approach as in the current research hence the uniqueness of the current research.

Research contribution # 1: Although the two literature backgrounds (customer satisfaction and rural water sustainability) strengthened the assumption that satisfied consumers may positively contribute towards sustainability, literature failed to provide enough evidence to support these linkages. The current research addressed this gap by showing the linkage between performance of the service level indicators and consumer satisfaction; then consumer satisfaction with consumer behaviour and this is the first research contribution.

Research contribution # 2: In relation to research findings, both from general and customer satisfaction specific literatures, the current research results first show that rural water is dependent on willingness of the consumer to sustain the facility. This consumer willingness is triggered by overall performance of the service level indicators. However the effectiveness of the pillars is dependent on multiple interacted factors that are referred to as root problem causes. The current research has identified thirteen root problem causes. According to Dew (1991) and Doggett (2005) knowledge of these root problem causes will assist in addressing the underlying issues of sustainability failure. This is the second contribution to knowledge.

Research contribution # 3 is that in addition to identification of root problem causes the current research has also empirically identified seventeen solutions specific to the root problems. In an event that a rural water supply problem is experienced then solutions specific for that problem has already been identified and packaged together as a prescription. Thirteen prescriptions have been developed in the current research.

Research contribution #4: The current research has established the satisfaction acceptable targets (SAT) for functionality and down time. Practically break downs and down times are inevitable however there are acceptable levels that trigger consumer dissatisfaction with a service. The current research has determined that SAT levels for functionality is "breakdowns of no more than 10 times in every six months" otherwise anything beyond the SAT level would trigger consumer dissatisfaction; secondly water point down time that takes more than 14 days to be fixed would result in consumer dissatisfaction so the SAT level for down time period is 14 days per break down.

Research contribution # 5 is on both satisfaction and rural water sustainability. With regard to satisfaction the current research provided empirical support to Oliver (1997) research on impact of customer satisfaction on loyalty and behaviour by showing that customer satisfaction can not only result to good intentions and loyalty but also positive customer behaviour. With regard to rural water sustainability the results clearly provides evidence of how satisfied consumers can result in sustainable rural water supply and how the opposite (dissatisfied consumers) can undermine rural water sustainability.

Research contribution # 6 is the major contribution to the body of knowledge and that is the development of a framework that will help managers, donors, policy makers, funders, Non-Governmental Organizations and governments in rolling out consumer satisfaction focused rural water projects. The framework is the major contribution as it is practical and frames a guide for implementation of consumer satisfaction focused rural water supply.

The current research provides a shift in direction to rural water supply sustainability which was exclusively focusing on shaping roles of the water management committee for sustainability. The new direction from the current research shifts the focus from the members of the water point management committee to the consumer who all along has been treated more as a beneficiary than as a customer. With the new knowledge contributed through the current research there will be an improved theoretical understanding of borehole rural water supply systems in Malawi. The perception and deliberate intention to focus on the consumer will also shape the future of rural water supply and help in providing quality rural water supply service that is self-sustaining.

## 6.4 Implications for Policy

The current research has important implications for policy makers. First and foremost, it responds to the need for sustainable rural water supply and informs the debate on rural water sustainability in Malawi by providing evidence about the relationship between consumer satisfaction and sustainability of rural water supply. These findings stress the impact of water supply service quality on consumer satisfaction and that improving customer satisfaction increases the likelihood of positive consumer behaviour for rural water supply sustainability.

In Malawi, the rural water supply has largely focused on increasing water infrastructure while overlooking sustainability (Kleemeier, 2000) now with the current research findings about what consumer satisfaction can achieve it is worthwhile integrating the framework into existing rural water supply approaches and models, thereby enhancing the existing approaches by increasing their effectiveness for sustainability. In line with these suggestions, consumer satisfaction based framework can be viewed as a unique approach to tackle problems of rural water supply sustainability.

## 6.5 Validity of Findings

Empirical data was corrected from multiple cases and were found to be valid, the current research had ten borehole case studies. The reason why all cases were boreholes is because the current research was on boreholes which is a predominant source of safe water in rural areas in Malawi. In the current research is was found that the findings were the same regardless of the case study in question and this justified the validity of the findings.

Strategies and solutions developed in the current research were based on a comparative analysis that was done where trends and patterns were established. This was possible

because of multiple case studies conducted in the current research. Solutions that are proposed in the current research were found to be working in another case and were justified to be the reason why those particular cases managed the desired state they were in.

Looking back into the current research it is clear that multiple means were used to collect data and this enabled cross check and verification of some information. Data was analysed using different methods like thematic analysis, root cause analysis and triangulation. This all helped in validating the findings in the current research.

## 6.6 Limitations and Directions for Future Research

Inquiry is a continuous and evolving process, thus, it cannot be, but incomplete, after a completion of a single study. This reflects the limitations that are inherent to every study (Feyerabend, 2010). With regard to the current research, limitations can be identified in aspects of methodology and the conceptualization of the key constructs within the context of rural water supply. These limitations could offer direction for future research.

First of all, and despite the choice of a mixed method research design as a way to deepen understanding of the phenomena under study and reduce the weakness of a pure quantitative or qualitative study, and to combine their strength then a number of challenges arose to that effect as follows:

The mix design imposed several difficulties on the researcher due to independent and self-funded nature of the current research. Utilising such a design requires more time and financial resources than mono method designs. As a result when one of these resources or both are limited, it is not possible to take full advantage of the designs strength of the mixed method. In other words, a mixed method design would be appropriate in a funded and /or team project.

The absence of a control group has limitations which make it difficult to interpret results, the use of control group with similar socio demographics and characteristics would have strengthened the results. It could be argued also that the limitations concern both the chosen approaches and the alternative ones that could have been chosen instead. The same applies to the chosen analytic methods as “every way of seeing is also a way of not seeing” (Silverman, 2003, p. 348).

## 6.7 Conclusions

The current research provides an optimistic view of the potential contribution of consumer satisfaction in rural water supply sustainability. It must be remembered that even after adoption of various frameworks and models in rural water supply sector sustainability levels has not improved yet suggesting the approaches missed some key elements of sustainability. That key element is about capturing the human interest or willingness of the consumer to sustain the water supplies. Literature of course classified the over sixty factors that affect sustainability into categories but not much on sustainability has been gotten from the classification process apart from systematic programming and financing of rural water projects.

Identification of the problem root causes from the current research is a breakthrough in the journey towards sustainability of rural water supply. In fact the sustainability prescriptions that are a result of packaging problem root causes and their proposed solutions brings on board “Do It Yourself” solutions in rural water supply sector. Solutions proposed in the current research are a result of evidence of success of some approaches in some borehole rural water supply case studies.

To this end the current research advances some recommendations for scholars, policy makers, researchers and practitioners. Looking at lessons learned from successful case studies and other initiatives it is now possible to make the consumer satisfied and in return deliver long term successful and sustainable borehole rural water supplies. In order to be successful in implementation of the new model the enabling environmental factors need to be ensured. Finally, the main objective of developing a consumer satisfaction based practical model for provision of sustainable rural water supplies has been achieved and a new era in the borehole rural water supply industry begins.

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# APPENDICES

## APPENDIX 1: Survey Questionnaire – water users questionnaire

| HOUSEHOLD IDENTIFICATION AND INTERVIEW SUMMARY |
|---|
| **District name:** _____ |
| **T/A:** _____ |
| **GVH:** _____ |
| **Village:** _____ |
| **Name of respondent:** _____ **Sex:** __**1 = Male 2 = Female)** |
| **Date of interview:** \|_____\|_____\|\|_____\|_____\|\|____\| _____\| |
| **Enumerator (Name)** _____ **CODE:** \|_____\|_____\| |

**Is questionnaire complete?** **Yes** |_____| **No** |_____|

**Name of supervisor:** _____ |____|____| **Date checked** |____|__||___|___||_ _|_ _|

## INTRODUCTION

Hello, My name is……..I am working on behalf of **PBM Consultants.** I have come to your house today because your household has been randomly selected out of all households in the area to participate in this survey. We want to learn more about your water facility. I would like to talk to you about your involvement with **Water facility**. Whatever you tell me will not be disclosed to anybody. You should not hesitate to say you do not understand a question, or do not know the answer. Would you be willing to talk to me? **Thank you.**

### Section 1 - General And Social Economic Status Of The Respondent

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q1 | Household Head<br><br>**Mutu wa banja** | 1 Male<br>2 Female<br>3 Child headed | |
| Q2 | Age of Household Head **(Zaka za mutu wa banja)** | | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q3 | What is the level of education for Household head?<br>**Kodi mutu wabanja lino maphunziro analekeza kalasi iti?** | 1 Adult literacy<br>2 Primary<br>3 Secondary<br>4 Tertiary<br>5 Did not attend<br>6 Dk | |
| Q4 | Where do you collect water for domestics use?<br>**Kodi madzi amene mumagwilitsa ntchito mumakawatunga kuti?**<br>**MULTIPLE RESPONSE POSSIBLE** | 1 Borehole<br>2 Protected dug well<br>3 Unprotected dug well<br>4 River/Stream<br>5 Tap | |
| Q5 | What is the average walking distance to the nearest safe water supply? **Kodi mumayenda mtunda wautali bwanji mukamapita kokatunga madzi?**<br>**Please Probe** | 1 Less than 500m<br>2 Between 500m and 1 Km<br>3 More than 1Km<br>4 More than 5Km | |
| Q6a | How often did the water source break down in the past six months? **Miyezi isanu ndi umodzi (6) yapitayi njigo wanu wakhala ukuonongeka kokwanila kangati?**<br>(Functionality indicator) | a = 0<br>b = 1 – 10times<br>c = 11- 20 times<br>d = Above 20 times | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q6b | How long did it take to repair the water supply facility?<br>**Njigo wanu ukaonongeka pamatenga nthawi yaitali bwanji kuti ukhonzedwe**<br>(Operation & Maintenance indicator) | a 1 – 48 hours<br>b 2 – 14 days<br>c 14 – 30 days<br>d More than 1 month | |
| Q6c | Who manages your water facility? **Kodi amene amayendetsa za njigo wanu ndi ndanu?** | a) Community based water committee<br>b) Rural private operator model<br>c) Public private Operator<br>d) Community leaders<br>e) Other | |
| **Section 2 – The Role Of The Consumer In Rural Water Supply Facility Sustainability** | | | |
| Q7 | What is your role as the consumer in rural water supply sustainability? **Kodi inuyo ngati munthu modzi ogwilitsa ntchito njigo mudzi muno, udindo wanu ndiwotani powonetsetsa kuti njigo wanu ndiwodalilika.**<br>***Multiple Response*** | 1 Water system maintenance<br>2 Water user fee contribution<br>3 Daily operation & maintenance<br>4 No role<br>5 Others (specify)<br>_____ | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| | **Section 3 – Consumers Perception Towards Rural Water Supply Sustainability (Rws)**<br><br>**Pillars** | | |
| Q9 | What do you think of planning as a factor for rural water sustainability? **Kodi Kukonzekera pamene njigo usanabwele kumafunika bwanji polingalira za kudalilika kwa njigo?** | 1 Very Important<br>2 Important<br>3 Not Important<br>4 Dk | |
| Q10 | What do you think of community participation as a factor for rural rural water sustainability? **Kodi Kutenga mbali kwa anthu amudzi muno njigo usanabwele kumafunika bwanji polingalira za kudalilika kwa njigo?** | 1 Very Important<br>2 Important<br>3 Not Important<br>4 Dk | |
| Q11 | What do you think of "gathering support" as a factor for rural water sustainability? **Kodi kupempha thandizo kaya mudzi muno kapena kwa mabungwe ndi magulu ena nkofunika motani polingalira za kudalilika kwa njigo?** | 1 Very Important<br>2 Important<br>3 Not Important<br>4 Dk | |
| Q12 | What do you think of management model as a factor for rural water sustainability? **Kodi gulu loyendetsa za kasamalilidwe ka njigo ndilofunika bwanji polingalira za kudalilika kwa njigo?** | 1 Very Important<br>2 Important<br>3 Not Important<br>4 Dk | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q13 | What do you think of technical skills and capacity as a factor for rural water sustainability? **Kodi luso ndi ukadaulo wa okonza njigo ndilofunika bwanji polingalira za kudalilika kwa njigo?** | 1 Very Important<br>2 Important<br>3 Not Important<br>4 Dk | |
| Q14 | What do you consider as other sustainability pillars of your water facility? **Kuonjezera pa zinthu takambazi ndi nsanamila zina zotani zofunika kuti njigo wanu ukhale wokhazikika ndi wodalilika?**<br><br>***Please expain*** | | |
| **Section 4 – Determinations Of (Dis) Satisfaction With Rural Water Supply** | | | |
| Q15 | What is the level of your satisfaction with your water facility<br>**Kodi muli okhutila bwanji ndi njingo umene mumakatungako madzi?** | 1 Very Satisfied<br>2 Satisfied<br>3 Low<br>4 Not Satisfied<br>5 Dk | |
| **Section 5 - Impact Of Sustainability Pillars On Consumers Overall Satisfaction** | | | |
| Q16a | What is the impact of the planning on your overall satisfaction as a water consumer? **Kodi panopa makonzekeredwe apa dzana paja akukukhudzani bwanji ndi mmene njigo ukugwilira ntchito pano?** | 1 Very High<br>2 High<br>3 Average<br>4 Low<br>5 None | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q16b | What is the impact of the community participation on your overall satisfaction as a water consumer? **Kodi katengedwe kambali ka anthu a mudzi muno pa kayendetsedwe ka njigo kakukhudzani bwanji ndi mmene njigo ukugwilira ntchito pano?** | 1 Very High<br>2 High<br>3 Average<br>4 Low<br>5 None | |
| Q16c | What is the impact of the support on your overall satisfaction as a water consumer? **Kodi thandizo lakayendetsedwe ka njigo likukhuzana bwanji ndi mmene njigo ukugwilira ntchito pano?** | 1 Very High<br>2 High<br>3 Average<br>4 Low<br>5 None | |
| Q16d | What is the impact of the Management model on your overall satisfaction as a water consumer? **Pa nkhani ya gulu loyendetsa za njigo yathandiza bwanji pa kukhutisidwa kwanu ndi mmene njigo ukuyendera pano.** | 1 Very High<br>2 High<br>3 Average<br>4 Low<br>5 None | |
| Q16e | What is the impact of the technical skills & capacity on your overall satisfaction as a water consumer? **Pa nkhani ya luso ndi ukadaulo wa a committee ndinu okhutira bwanji kuti njigo wanu ndi wokhazikika komanso wodalirika?** | 1 Very High<br>2 High<br>3 Average<br>4 Low<br>5 None | |
| **Section 6 – Impact of overall satisfaction on willingness to functionally sustain the water facility through certain desired behaviours** | | | |
| Q17 | In your opinion, how do you rank the following sustainability pillars as key contributors to your overall satisfaction with the water facility?<br>**Pa nsanamila takambilana zija zokhuza kukhazikika ka njigo, mungaziike pa mulingo uti polingalira kukhazikika kwa njigo?**<br>*Chonde lembani ma code awa munsimu:* **(1) Very High (2) High (3) Average (4) Low (5) Not important** | | |

| # | QUESTION | RESPONSE CODES | SKIP |
|---|---|---|---|
| Q17a | Planning **Kakonzekeledwe pa za njigo** | | |
| Q17b | Community participation **Kutengapo mbali kwa anthu eniake** | | |
| Q17c | Support **Chithandizo** | | |
| Q17d | Management model **Gulu loyang'anira za pa njigo** | | |
| Q17e | Technical skills and capacity **Luso ndi ukadaulo pa za njigo** | | |
| Q18 | As a rural water consumer and considering your current level of satisfaction with how your water facility is performing what is the likelihood that you can be motivated to contribute whether cash or in-kind to its operation?<br><br>**Inuyo ngati mmodzi mwa anthu amene mumagwiritsa ntchito mjigowu komanso poganizira za kukhutira kwanu ndimene njigowu ukugwilira ntchito ndinu ozipereka bwanji pa kutengapo gawo pa kayendetsedwe ka njigo?** | 1 Very high<br>2 High<br>3 Moderate<br>4 Low<br>5 None | |

**END OF INTERVIEW**

## APPENDIX 2: Interview Guide

1. From where do you collect your drinking water for your household? Are you satisfied with the water source sustainability?
2. What is your understanding of rural water supply sustainability? (Then explain this current research definition of sustainability)
3. What is expected from members of the community for the sustainability of the water point? Do you think any of these could be useful as roles of the consumer anymore? How do you explain this? Is there anything else?
4. What else do you think consumers could be doing to ensure long time sustainability of the water point? Consider keeping the water flowing all time, consider future planning, future expansion, fundraising, technical knowhow, consider management model.
5. What do you think are the pillars of a sustainable rural water supply? How would you feel as a consumer if your water point did not have any of these pillars in place? How do you explain this? Is there anything else?
6. What are the the problem root causes that cause failure of the sustainability pillars? What would be the solutions to the problem? Is there anything else?
7. What makes you feel dissatisfied with your water point? Do you think any of these would affect you on your motivation to take care of your water facility? How do you explain this? Is there anything else?
8. What makes you feel satisfied with your water facility? Do you think any of these would affect your motivation to take care of your facility? How do you explain this? Is there anything else?

# APPENDIX 3: Notes during familiarization of data

**UNDERSTANDING OF SUSTAINABILITY**

Continuous flow of water

Queuing at the water point (time spent at the water point)

Good quantities of water

Repairable (easy to maintain)

**ARE YOU SATISFIED WITH WATER POINT**

NO - low yield

NO – seasonal access of water

NO - poor functionality

NO - long water collection waiting time

NO - high user to borehole ratio

NO – High incidences of water conflicts

YES – Clean and Safe water

YES – Low sickness incidences

YES – Reliable continuous flow of water

YES - Short water collection distance

YES – Good punctuality

YES - Good leadership

**THE NOT SATISFIED – WHAT MAKES YOU FEEL THE WATER POINT WILL NOT BE SUSTAINABLE**

Poor construction quality

Long water collecting waiting time

High incidences of water conflicts

Wrong location of water point

**ROLES OF THE CONSUMER**

Financial contribution for Operation and Maintenance

Hands on maintenance of the water point

Water point cleaning

Water point operation

Contribution of materials required for the water point

**ROLES OF THE WATER POINT COMMITTEE**

Set up rules for management of water point

Source water point spare parts

Source support for water point maintenance

Train users on water point operation

Reinforce the rules of the water point

Do minor repairs of the water point

In charge of the water point

Lead in maintenance

**RANKING OF ROLES OF THE CONSUMER**

Fundraising for the borehole

Water point cleaning

Proper operation of the water point

**WHAT MAKES THE CONSUMER SATISFIED**

Ownership

Continuous flow of water

Low incidences of water conflicts

Good quality of water

Low incidences of water related sicknesses

**WHAT MAKES THE CONSUMER DISSATISFIED**

High user to borehole ratio

High incidences of water conflicts

Long water collection waiting time

Poor construction quality

Long walking distance

Seasonal supply of water

Low quantity of water

**EFFECT OF SATISFACTION ON THE CONSUMER**

Increased motivation to contribute financially

Increased motivation to contribute materially

Increased willingness to ensure the water point is clean

Increased security of the water point

Willingness to fundraise for the water point

**EFFECT OF DISATISFACTION ON THE CONSUMER**

Abandon the water point for other water point

Bad mouthing

Water conflicts rise

High water point committee members drop outs

Poor sanitation and hygiene on the borehole

No motivation to participate in fundraising

No motivation to contribute materially

Consumers are detached from the water point

**OUTCOME OF CONSUMER SATISFACTION ON CONSUMER BEHAVIOUR**

Motivation to work towards water supply sustainability

Determination to fundraise

Willingness to participate

# APPENDIX 4: Assigning initial codes

**UNDERSTANDING OF SUSTAINABILITY**

1- Continuous flow of water

2- Reasonable/acceptable water collection spent time

3- Adequate quantities of water

4-Repairable (easy to maintain)

**ARE YOU SATISFIED WITH WATER POINT**

5- Satisfactory rate of recharge

1- Continuous flow of water (NO – seasonal access of water)

6- Functionality (NO - poor functionality)

2- Reasonable/acceptable water collection spent time

(NO - long water collection waiting time)

7 – User borehole ratio (NO - high user to borehole ratio)

8 – Water conflicts (NO – High incidences of water conflicts)

9- Water quality (YES – Clean and Safe water)

10- Health benefits (YES – Low sickness incidences)

1- Continuous flow of water (YES – Reliable continuous flow of water)

11- Collection distance (YES - Short water collection distance)

6- Functionality (YES – Good functionality)

12 – Leadership (YES - Good leadership)

**THE NOT SATISFIED – WHAT MAKES YOU FEEL THE WATER POINT WILL NOT BE SUSTAINABLE**

13-Poor construction quality

2-Long water collecting waiting time

8-High incidences of water conflicts

14-Wrong location of water point

**ROLES OF THE CONSUMER**

15-Financial contribution for Operation and Maintenance

16-Hands on maintenance of the water point

17-Water point cleaning

18-Water point operation

19-Contribution of materials required for the water point

**ROLES OF THE WATER POINT COMMITTEE**

20-Set up rules for management of water point

21-Source water point spare parts

22-Source support for water point maintenance

23-Train users on water point operation

24-Reinforce the rules of the water point

16-Do minor repairs of the water point

25-In charge of the water point

26-Lead in maintenance

**RANKING OF ROLES OF THE CONSUMER**

15-Fundraising for the borehole

17-Water point cleaning

18-Proper operation of the water point

**WHAT MAKES THE CONSUMER SATISFIED**

27-Ownership

1-Continuous flow of water

8-Low incidences of water conflicts

9-Good quality of water

9-Low incidences of water related sicknesses

**WHAT MAKES THE CONSUMER DISSATISFIED**

7-High user to borehole ratio

8-High incidences of water conflicts

2-Long water collection waiting time

13-Poor construction quality

14-Long walking distance

1-Seasonal supply of water

3-Low quantity of water

**EFFECT OF SATISFACTION ON THE CONSUMER**

15-Increased motivation to contribute financially

19-Increased motivation to contribute materially

17-Increased willingness to ensure the water point is clean

27-Increased security of the water point

15-Willingness to fundraise for the water point

**EFFECT OF DISATISFACTION ON THE CONSUMER**

28-Abandon the water point for other water point

8-Bad mouthing

8-Water conflicts rise

29-High water point committee members drop outs

17-Poor sanitation and hygiene on the borehole

15-No motivation to participate in fundraising

19-No motivation to contribute materially

28-Consumers are detached from the water point

**WATER POINT LIFE CYCLE CONSUMER SATIFACTION**

**WHAT MAKES THE CONSUMER SATISFIED AT INITIATION AND DESIGN STAGE**

30-Articulation of community felt need

19-Community involvement in mobilising materials

15-Community involvement in raising funds

30-Community demand of service

31-Community unity for the service

12-Strong leadership that speaks for the community

**WHAT MAKES THE CONSUMER SATISFIED AT CONSTRUCTION**

32-Community involvement on construction work

13-Execution quality of Construction work

**WHAT MAKES THE CONSUMER SATISFIED AT COMMISSIONING STAGE**

27-Ownership

33-External support assurance

**WHAT MAKES THE CONSUMER SATISFIED AT POST CONSTRUCTION STAGE**

33-External support access

34-Continuous training

21-Spare parts supply chain access

**OUTCOME OF CONSUMER SATISFACTION ON CONSUMER BEHAVIOUR**

15, 19, 17-Motivation to work towards water supply sustainability

15-Determination to fundraise

15, 19, 17-Willingness to participate

END